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Proceedings of the Thirty-Third Annual Meeting of the American Association of Economic Entomologists—(*Continued*)

Morning Session, Thursday, December 30, 9.35 a. m.

PRESIDENT WILMON NEWELL: The first paper on the program is by S. W. Bilsing.

THE PECAN NUT CASE BEARER (ACROBASIS CARYAEVORELLA)

By S. W. BILSING

The pecan nut case bearer in its larval stage is the most important insect enemy of the pecan industry in Texas. The author has conducted a series of spraying experiments extending over several years to find a possible control for this insect.

There are three generations during the year. The larva of this insect passes the winter in the larval burrow at the base of the buds. These larvae become active about the time the buds start in the spring. The moths which come from these overwintering larvae begin to emerge during the latter part of April and continue to emerge for about twenty days. The eggs are laid in the center of the pistil of the nut from three to nine days after emergence. The egg hatches about five days after deposition and the young larva usually attacks the buds on the limb below the nut cluster. In a few days it returns to the nut cluster and begins boring into the nuts at the base. The nuts are attacked when they are very small, scarcely larger than an ordinary pea. The presence of a larva in a nut is indicated by the excrement and frass which projects from the opening at the base of the nut through which the larva entered. The nut drops to the ground after the interior is hollowed out and as the nuts are very small at this time one larva may destroy a large number of nuts before it has reached maturity. The larva reaches maturity

in twenty-five to twenty-nine days at which time it pupates within the nut. The nuts are usually webbed together by the larvae and the pupal stage is passed in nuts which are tied fast in this way on the tree. Altho there are three generations very little damage is done except by the first generation. Due to the fact that the nuts are so small at this time, the damage is little noticed. Sometimes the second generation destroys a considerable number of nuts but as a rule it is the first which does the major portion of the damage.

It was estimated last year (1919) that there were produced in Texas about one thousand cars of pecans. The past season (1920) there was almost an absolute failure of the pecan crop. Nearly all pecan growers are of the opinion that the failure was due to frost. The same opinion is given in reports of the United States Bureau of Markets. That such was not the case may be seen by examining the following tables. The following series of experiments were conducted at Corsicana, Texas, in an orchard of about six hundred trees. This place was admirably suited for such an experiment because all the trees are Halberts and about ten years old. A portion of the orchard comprising fifty trees were used in this experiment. These trees were about of the same size and age and according to the owner, Mr. J. M. Blackburn, of about the same bearing capacity. These trees were arranged as nearly as possible in plots of fours according to their size. Four were sprayed and the next set of four were not sprayed. Once each week the nuts from each tree which had fallen to the ground were collected and counted. The number which had fallen because of the attacks of the case bearer larva were tabulated in one column and those which had fallen from other causes were tabulated in another.

In spraying pecans it is necessary to use a first-class power sprayer which will maintain at least two hundred and fifty pounds pressure. One which will keep a pressure of three hundred and fifty pounds is better. One of the standard makes of spray guns is also desirable as more efficient work can be done with a spray gun than with a nozzle. The orchard was first sprayed May 8 with arsenate of lead at the rate of three pounds per fifty gallons of water. A second spraying was made May 22. These two applications were made for the first brood larvae. A third spraying was made on June 26 for the second brood of larvae. Some years it is necessary to make this application but the past season it was unnecessary since the number of larva of the second generation was so small that they did very little damage. In 1919 however, the second generation of larvae did considerable damage and this application was necessary. The control of the insect can best be accomplished in the first generation.

Another series of spraying experiments was tried in a pecan orchard at College Station with calcium arsenate which yielded negative results. As this orchard is about one hundred miles from the Corsicana orchard it is impossible to say at the present time if the difference was due to differences in rainfall or to the differences between calcium arsenate and arsenate of lead. It will be necessary to repeat this in order to determine the exact cause.

PLOT I—UNSPRAYED

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent on Tree Sept. 27
	Inf.	Non.					
1	817	68	19	904	90%	10%	2%
2	1004	119	16	1139	88%	12%	2%
3	1990	227	30	2247	89%	11%	1%
4	309	38	0	347	89%	11%	0%

PLOT II—SPRAYED

First Spraying .....May 8 .....Arsenate of lead 3 lbs.; water 50 gal.
Second Spraying ....May 22 .....Arsenate of lead 3 lbs.; water 50 gal.
Third Spraying .....June 26 .....Arsenate of lead 3 lbs.; water 50 gal.

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
5	133	222	1140	1495	9%	91%	76%
6	75	105	781	961	8%	92%	81%
7	69	175	383	627	11%	89%	71%
8	119	193	877	1189	10%	90%	74%

PLOT III—UNSPRAYED

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
9	733	162	62	957	77%	23%	6%
10	1149	226	35	1410	81%	19%	3%
15	225	36	24	285	79%	21%	8%
16	1165	235	30	1430	81%	19%	3%

PLOT IV—SPRAYED

First Spraying ....May 8 .....Arsenate of lead 3 lbs.; water 50 gal.
Second Spraying ..May 22 .....Arsenate of lead 3 lbs.; water 50 gal.
Third Spraying ...June 26 .....Arsenate of lead 3 lbs.; water 50 gal.

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
11	255	307	1008	1570	16%	84%	64%
12	126	191	841	1158	11%	89%	73%
13	81	213	908	1202	7%	93%	75%
14	65	250	774	1089	5%	95%	81%

PLOT V—SPRAYED

First Spraying ....May 8 .....Arsenate of lead 3 lbs.; water 50 gal.
Second Spraying ...May 22 .....Arsenate of lead 3 lbs.; water 50 gal.
Third Spraying ...June 26 .....Arsenate of lead 3 lbs.; water 50 gal.

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent Infested	Percent Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
17	87	133	754	974	9%	91%	77%
19	186	359	1001	1546	12%	88%	65%
22	86	97	304	487	18%	82%	62%

PLOT VI—UNSPRAYED

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
18	591	107	26	724	82%	18%	3%
20	999	192	112	1303	77%	23%	8%
21	469	95	18	582	81%	19%	3%

PLOT VII—SPRAYED

First Spraying ....May 8 .....Arsenate of lead 3 lbs.; water 50 gal.
Second Spraying ..May 22 .....Arsenate of lead 3 lbs.; water 50 gal.
Third Spraying ...June 26 .....Arsenate of lead 3 lbs.; water 50 gal.

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
23	39	17	52	108	36%	64%	48%
24	33	112	427	572	6%	94%	74%
25	165	230	787	1182	14%	86%	75%
26	237	176	635	1048	23%	77%	60%

PLOT VIII—UNSPRAYED

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
27	1670	241	46	1957	85%	15%	3%
28	568	112	12	692	82%	18%	2%
29	723	145	58	926	78%	22%	6%
30	222	28	40	290	76%	24%	14%

PLOT IX—UNSPRAYED

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
31	1094	155	75	1324	83%	17%	5%
34	683	54	10	747	91%	9%	2%
35	681	62	0	743	92%	8%	0%

PLOT X—SPRAYED

First Spraying ....May 8 .....Arsenate of lead 3 lbs.; water 50 gal.
Second Spraying ..May 22 .....Arsenate of lead 3 lbs.; water 50 gal.
Third Spraying ...June 26 .....Arsenate of lead 3 lbs.; water 50 gal.

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
32	120	262	904	1286	9%	91%	71%
33	69	137	293	499	13%	87%	60%
37	36	92	683	811	44%	56%	45%
38	164	222	765	1151	14%	86%	67%

PLOT XI—UNSPRAYED

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
39	653	45	8	706	92%	8%	2%
40	187	40	13	240	78%	22%	5%
41	451	31	0	482	94%	6%	0%
44	967	93	16	1076	90%	10%	1%

PLOT XII—SPRAYED

First Spraying ....May 8 .....Arsenate of lead 3 lbs.; water 50 gal.
Second Spraying ..May 22 .....Arsenate of lead 3 lbs.; water 50 gal.
Third Spraying ...June 26 .....Arsenate of lead 3 lbs.; water 50 gal.

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
42	44	173	688	905	5%	95%	76%
43	139	269	851	1259	11%	89%	68%
45	24	68	326	418	6%	94%	78%

PLOT XIII—UNSPRAYED

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
46	72	14	7	93	77%	23%	8%
47	133	24	11	168	79%	21%	7%
49	305	36	0	341	89%	11%	0%

PLOT XIV—SPRAYED

First Spraying ....May 8 .....Arsenate of lead 3 lbs.; water 50 gal.
Second Spraying ..May 22 .....Arsenate of lead 3 lbs.; water 50 gal.
Third Spraying ...June 26 .....Arsenate of lead 3 lbs.; water 50 gal.

No. Tree	Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
	Inf.	Non.					
48	14	35	121	170	8%	92%	71%
50	70	116	253	439	16%	84%	58%
52	32	58	137	227	14%	86%	60%

SUMMARY—SPRAYED TREES

Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
Inf.	Non-Inf.					
2468	4212	15695	22375	11%	89%	70%

SUMMARY—UNSPRAYED TREES

Dropped Nuts		Nuts on Tree Sept. 27	Total Nuts Borne	Percent. Infested	Percent. Non-Inf.	Percent. on Tree Sept. 27
Inf.	Non-Inf.					
17860	2585	668	21113	85%	15%	3%

MR. H. A. GOSSARD: What was the average cost per season for spraying a tree and what was the average return received per tree by the growers? I mean the cash return at the end of the season.

MR. S. W. BILSING: I havn't those figures present, but as I remember it cost about ninety cents per tree, including the cost of arsenate of lead and the labor and everything. The trees sprayed were about fifteen or twenty feet high. I think the returns above the cost were something between $4 and $5 a tree. I cannot now give the exact figures.

PRESIDENT WILMON NEWELL: The next paper is by R. L. Webster.

FUMIGATION WITH HYDROGEN CYANIDE FOR THE CONTROL OF THE PEAR PSYLLA

By R. L. WEBSTER, *Ithaca, N. Y.*

(Paper withdrawn for publication elsewhere)

MR. H. A. GOSSARD: I would like to know if fumigation is a possible method for eradication in small areas? We have, so far as I know, only one center of psylla infestation in the state of Ohio, and this is very small With sufficient equipment, the work might be done in, say one night. Would there be any possibility of exterminating the psylla by this method?

MR. R. L. WEBSTER: I think you can very nearly do that. In the first orchard I fumigated in the spring of 1919, the psylla has not come back to be of any importance. That has not been true of other orchards, however, where there has been reinfestation from the outside. In one case there was considerable infestation from the timber adjacent. In some experiments which Professor Parrott made about three years ago, the psylla has not come back in sufficient numbers to require further treatment.

MR. H. A. GOSSARD: I would like to ask if any one can report on the success that the California people have had from using balloons for the purpose of dropping these tents over large trees?

MR. E. R. SASSCER: While on my way to California last spring, my attention was drawn to an article in, I think, *Popular Science Monthly*, to the effect that balloons were to be employed in placing tents over trees for fumigation. On my arrival in Alhambra, I asked Mr. Woglum if balloons were being used for the purpose stated, and he replied that some one had suggested their use, but so far as he knows, little progress has been made. It is safe to say that they are not at the present time being used in commercial groves.

PRESIDENT WILMON NEWELL: The next paper is by Alvah Peterson.

SOME EXPERIMENTS WITH PARADICHLOROBENZENE AND OTHER CHEMICALS FOR THE CONTROL OF THE PEACH TREE BORER, *SANNINOIDEA EXITIOSA* SAY

By ALVAH PETERSON, *New Brunswick, N. J.*

(Withdrawn for publication elsewhere)

MR. GEORGE A. DEAN: At what maximum depth were the larvae killed?

MR. ALVAH PETERSON: The majority of the larvae are located above the point where the large roots branch from the tree. Worms below this point are few in number and are rather difficult to kill.

MR. GEORGE A. DEAN: Have experiments been carried on in connection with the woolly aphis?

MR. ALVAH PETERSON: Mr. Blakeslee has shown that this material cannot be used on apple trees, as it seriously injures them.

MR. WILLIAM MOORE: Many years ago, I think in the 80's, Hilgard of California pointed out that the phenomenon of adsorption is very important in the treatment of underground insects.

I would like to ask if Mr. Peterson has carried out any experiments on the adsorption of paradichlorobenzene by the soil?

MR. ALVAH PETERSON: I have not.

A MEMBER: I would like to ask what results have been secured with orthodichlorobenzene?

MR. ALVAH PETERSON: Orthodichlorobenzene is a liquid and our experience shows that it is injurious to peach trees, and should not be used. We killed more than one hundred trees this summer by using it.

Mercuric chloride gives considerable promise of being an effective insecticide against the young borers in the trees. It was used in the same way that it has been applied in Canada for the control of the onion maggot. Further experiments will be conducted along this line.

MR. H. F. DEITZ: Where can paradichlorobenzene be purchased?

MR. ALVAH PETERSON: From the Hooker Electro-Chemical Co., 25 Pine St., New York City; The Niagara Alkali Co., Niagara Falls, N. Y., or E. C. Klipstein & Sons Co., 344 Greenwich St., New York City.

MR. A. L. QUAINTANCE: I have been very much interested in the experiments reported by Mr. Peterson. They conform so closely to comparisons obtained by the Bureau of Entomology, that the members may be interested to know that there is available a publication on this subject and the treatment has already obtained large commercial use. It has been used extensively in the Ozark region of Missouri and Arkansas. In the peach belt in Georgia it has now been tried for two or three years on a large commercial scale, and we are in a position to judge somewhat of its effectiveness and its likelihood of injuring the trees. To date we have had no serious complaint of tree injury; on the other hand, we have had numerous assurances that this was the long-sought treatment for the peach tree borer.

PRESIDENT WILMON NEWELL: The next is a paper by Mr. Glenn W. Herrick.

THE CODLING MOTH—A QUANDRAY AND A QUERY[1]

By G. W. HERRICK, *Cornell University, Ithaca, N. Y.*

Unquestionably the control of the injuries of the codling moth still constitutes the most important entomological problem confronting the apple grower in his attempt to produce clean, A-grade fruit, at least in Western New York. The serious phase of the problem to-day in the production of smooth fruit consists of the so-called side-worm injury in which shallow, circular, or elongated cavities are eaten out of the flesh of the fruit almost anywhere on the surface of the apple. This phase of injury which has assumed more and more prominence in the last few years has complicated the matter of control and it seems destined to modify our recommendations regarding the number and frequency of the applications of spray material. Indeed, certain entomologists as a result of their experience and observations have already shown a tendency to modify the emphasis which they have heretofore placed on the calyx spray and to extend this emphasis to subsequent applications of poison.

I was first impressed with the importance and complexity of this whole matter of side injury by Dr. Pettey's data in regard to the work of codling moth on pears in South Africa. His data were first embodied in an unpublished thesis and afterwards partly published as Bulletin 9 of the Department of Agriculture of South Africa (1916). Briefly, Pettey shows that comparatively few larvae enter the calyx cup of the unsprayed Beurré Hardy Pear while a very large number enter the sides. On the other hand, in the case of the Kieffer and Bosc large numbers enter the calyx and a much smaller number go in through the sides. A study of the calyces of these varieties shows that the calyx of the Beurré Hardy pear remains wide open "with a clean base due to the total disappearance of stamens and pistils" while the calyx of Kieffer, for example, shows a very complete closure. Petty concludes "that the greater the degree of closure of the calyx cup the greater the percentage of larvae that enter the calyx proper." This work of Petty's has certainly been suggestive and may throw some light on the problem of codling moth-control in this country.

Turning to the problem as it exists in the United States we may well consider briefly the significance of some investigations in this country. For example, Woodworth writing in 1913 said that in the Pajaro Valley in California it was observed that the great majority of the larvae entered elsewhere than through the calyx and that in Sutter county

[1]The nature of this paper is the result of the Secretary's suggestion that those who present papers "will discuss broad general topics rather than those of local interest."

only a third of the worms entered at the calyx. He also said "it was noticed that spraying was completely effective in the Pajaro Valley when applied long after the calyx is closed and in the Sacramento Valley good results followed when only two or three per cent of the cups showed an appreciable amount of the spray." He concludes with this significant statement "it will thus be seen that we do not know enough of the facts to explain the reasons for the efficiency of the poison".

Strickland (1920) has shown that this side-worm injury is abundant, and difficult to control in the apple region of Western New York in the Ontario plain region. He says, "a large majority of the larvae enter through the sides of the apple" and speaks of "this new factor of shallow and deep work of the codling moth" and of the importance of it because the defects will become more conspicuous when growers begin, as they surely will, to make a uniform pack based on color, size, and smoothness of fruit. He suggests the importance of applications of spray material subsequent to the calyx spray and seems to think emphasis should be placed on these later sprayings.

Childs (1920) says that during some seasons in Oregon "a very high percentage of the worms enter through the calyx and during others the reverse would be true." Apparently the proportion of worms entering the calyx and sides varies also with the variety. For example, Childs says, in an orchard of Spitzenburgs 66.96 per cent of the worms entered the sides while only 33.04 per cent were calyx worms. In a block of Newtowns 61.54 per cent were side worms and 38.48 per cent were calyx worms. On the other hand, in a block of Arkansas Black 31.68 per cent were side worms and 68.32 per cent were calyx worms.

It is perfectly evident that we haven't all of the facts concerning the larvae and their habits relative to their manner of entering the apple. Moreover, it would appear that the habits of the larvae in attacking the apple have an important bearing on the methods of control, especially on the manner in which the poisons should be applied. There is also another factor which I believe has an important bearing on this vexing question of control and that is, the great variation in the time of appearance of the codling moth in the spring from one season to another.

In our work with the codling moth in 1911 and 1912 R. W. Braucher, who carried out the work in the field, showed that the moths appeared and laid their eggs fully two weeks earlier in 1911 than in 1912. Strickland (1920) points out that in the Ontario region of New York, "the egg laying period for 1919 started ten days earlier than any other year since 1912" and the season of 1919 was what we may call a codling moth year. It appears from a superficial view of the work of the insect that in years in which it is abundant a greater proportion of the larvae enters

through the sides of the fruit. This, however, may not be borne out by a careful investigation of the actual facts.

When I consider the foregoing facts which have been inadequately and briefly stated I become lost in a quandry regarding the most effective method of control for the codling moth and the following questions suggest themselves:

1. Will it not be necessary for us to determine the habits of the larvae in any given region before being able to recommend reasonably effective control measures?

2. Is there a marked difference in the degree of calyx closure in different varieties of apples and if so is this a determining factor of the ratio of side and calyx entrants?

3. Should not this matter of calyx closure and its relation to the habits of the larvae be more fully investigated?

4. Do the rapidity and degree of calyx closure vary with the seasons and if so are they correlated with the ratio of side and calyx entrants?

5. Does the great variation in appearance of the moths in spring in different seasons bear any relation to the ratio of side and calyx entrants during that season?

6. Should not this whole question be investigated from a new angle and with a somewhat new viewpoint?

7. Is there not here a fine opportunity for a piece of cooperative research covering the whole apple area of the United States which may result in a fund of information on which we may be able to base more rational and effective methods of control?

It may be that the project is broad enough to be brought before the national Research Council for its aid and encouragement. Personally, I believe I could use a considerable sum annually for the next five years in a profitable investigation of this problem with the foregoing facts as a background.

The question is broad enough to interest the chemist and possibly the physicist. I am particularly impressed with the desirability of enlisting the chemist when I am reminded of the problem of the assimilation of some forms of poison and the non-assimilation of other forms by caterpillars and the consequent effectiveness of some arsenates and the ineffectiveness of others. I am also impressed with the possible aid that the chemist can give in this problem and perhaps the physicist also, when I recall the meager but very interesting and highly promising work that has been done with the so-called "spreaders" and "stickers" that have been added to poison spray materials to produce a complete and permanent film over foliage and fruit so that nowhere can a caterpillar find unpoisoned food. I believe we are on the threshold of important advances in control methods for insect pests.

My real query is, are we now making the most rational recommendations for the most effective control of the codling moth?

References

1913 WOODWORTH, C. W.—Calif. Expt. Stat., Circ. 101.
1916 PETTEY, F. W.—Union of South Africa, Dept. Agr. Science, Bull. No. 9.
1920 CHILDS, LEROY—Jr. Ec. Ent., Vol. 13, p. 331.
1920 STRICKLAND, L. F.—*The Cornell Countryman*, Vol. XVII (April) p. 395.

MR. R. W. BRAUCHER: I can answer some of these queries partially from the experience that I have had in studying the codling moth in Michigan from 1908 to 1910 and in New York State from 1911 to 1913. In regard to the variation in the opening and closing of the calyx, I have observed a decided variation from season to season. In New York in 1912 we had some cold weather that retarded blossoming for several days followed by warm weather. The blossoms began to open on Friday, by Sunday they were in full bloom and the petals starting to fall. By Thursday the calyx on some of the Baldwins was closed tight and most of them too far closed for successful spraying. Some were even closed too much for successful spraying by Monday evening or Tuesday. In 1913 we had warm weather until the apple trees started to blossom when it turned cold with freezing weather. This season the calyx was open and in good condition for spraying for nearly a month. A crop was secured in spite of this unfavorable weather. Similar cases were observed in Michigan. At Lincoln, Illinois, in 1919 we had a hard freeze during the blossoming period with the temperature at 23 and 24 degrees two successive nights as recorded by a government maximum and minimum thermometer. This also retarded the closing of the calyx for two to three weeks but did not kill the fruit in healthy, sprayed orchards. The spring had been dry up to the time of the freeze.

In regard to side worms I have also noted marked variations. In Michigan in 1910 we had a very early spring with freezes during the blossoming period, resulting in the slow closing of the calyx and a short crop. Side worms were unusually abundant. The result of the spraying experiments carried on that year were very interesting but have not been published. These results convinced me that, under certain conditions at least, if the calyx is thoroughly filled with spray many of the codling moth larvae will enter the calyx but will leave it and enter the side of the apple.

MR. A. L. MELANDER: In dealing with the codling moth in the Pacific Northwest, we are emphasizing spraying for the first brood. The fruit grower who can give one or two or three thorough applications for the first brood usually has no fear whatever of side-entering worms. There

is one important thing that has usually been overlooked in codling moth control that year by year is impressing itself on me, and is perhaps one of its most important aspects, namely, the thinning of the fruit at the time that the first brood worms are in the apples. The commercial orchardist thins the fruit with an eye to taking off the wormy apples. The calyx spraying alone plus the thinning has frequently been all sufficient in producing one hundred per cent. clean fruit. Usually, however, the thinning is not perfectly done and the side sprays become necessary, but I do not know from personal experience how widely the thinning of the fruit is carried on in the commercial orchards of the Middle and Eastern States. It may be a totally impractical thing in the very large apple trees of New England and New York, but with the younger trees prevalent in the West, thinning for wormy apples is a regular accomplishment in codling moth control, and I believe it is worth as much as all the cover spraying put together.

MR. R. W. BRAUCHER: There is another point I would like to emphasize, and that is in the control of the codling moth there is a necessity of making a study of the insect each year and varying the spraying campaign to correspond with the life history of the insect during that season. There is such a variation between the life cycle of the codling moth and the life cycle of the tree that it is misleading to attempt to give recommendations according to the development of the tree. In one season you may get excellent results and in another season you may get very poor results.

The necessity of the cover sprays to prevent the side worms must be realized, and this method used much more extensively in certain seasons than in others on account of the difference in the abundance of the codling moth larvae.

Adjournment.

Section of Horticultural Inspection

Thursday afternoon, December 30, 2.15 p. m.

The meeting of the Section of Horticultural Inspection of the American Association of Economic Entomologists was held Thursday afternoon, December 30, 1920, at the University of Chicago, and was called to order at 2.15 p. m. by the Chairman, Mr. J. G. Sanders of Harrisburg, Pa.

CHAIRMAN SANDERS: The Chairmen of this Section, in the past, have not been accustomed to give an address, but on the special request of the Secretary of the Section, the Chairman has prepared a short address which he will read at this time.

THE TREND OF HORTICULTURAL INSPECTION

By J. G. SANDERS, *State Capitol, Harrisburg, Pa.*

Horticultural inspection is essentially and perforce an American institution. It is a child of necessity—that need of a guardianship thrown around our agriculture and horticulture to protect them from the introduction and establishment of new and potential pests from foreign lands; likewise this guardianship is exercised to prevent, if possible, undue and rapid spread of pests already established within our borders, or those even more localized.

The history of our earliest endeavors along the lines of horticultural inspection and quarantines as reviewed at this period, reveals some admittedly unwise and drastic actions, which have hampered certain horticultural interests, and doubtless have caused, in the aggregate, considerable actual loss. I believe we are safe in our assurance, that zealous efforts to perform duty, sometimes perhaps in the absence of the best of training and experience, alone have caused unnecessary inconvenience and losses to horticulture.

Reports have been circulated that inspectors have condemned shipments without reasons other than to "show their authority," and to appear active in their positions. If there are such inspectors, they are not worthy of the consideration of decent men and scientific horticultural officers, and as such can not be too strongly condemned. The horticultural inspector who can not see the larger work, of which his effort is but a small part, and who is so untrained and so unobserving of the hosts of horticultural pests demanding constant alertness, that he must use unnecessarily drastic and ruinous orders, should be classed with the school examiner whose limitations of knowledge forces him to the use of "catch questions" to fill a list of only ten examination questions. Their day is past.

Great improvements are apparent everywhere in methods of inspection, certification, and quarantine. No longer do we frantically cut down large fruit orchards on account of a few individuals of the once dreaded San José scale. We have learned through a long series of years and experimentation to cope readily with this pest through spraying methods. This improvement in horticultural inspection is primarily the outgrowth of experience based on past history, on better training, better organization, and best of all, more general and hearty cooperation of existing agencies and factors.

A considerable change in feeling on the part of our nurserymen toward horticultural inspection is in evidence in these latter years, since they have begun to realize what they should have realized much earlier, that

the efforts of the horticultural inspector were directed primarily toward the salvation of horticulture. With dangerous pests threatening, the old days of a discordant attitude on the part of the nurserymen, we are glad to say, has in most instances changed to a satisfactory cooperation, and even in the instance of the more advanced type of nurserymen, a ready welcome, and even an invitation to visit the nursery stands at all times.

It is to the everlasting honor and credit of the American Association of Nurserymen that definite and organized steps are being taken by that body to purge itself of those nurserymen who have proven unworthy of membership in that body. If the activities of their vigilance committee can be judged as a criterion of their endeavors, the future holds forth bright promise of a distinctly elevated group of horticulturists in this national body. How desirable would have been such action a decade ago, but as Tennyson once said, "Science moves on slowly from point to point," so it seems that only by gradual degrees are we able to advance to better things. We should not be deceived, however, that all nurserymen have had a change of heart with respect to the inspection service of the states and Federal Government, because we may expect, as in any other line of effort the personal equation of mediocrity to appear and to offset a certain portion of the good intentions of the higher minded.

State Cooperation

The horticultural inspection service at large deals with a problem which extends beyond the inspector's own realm, and his work at once becomes either a help or a hindrance to another in this line. It seems that at no time in our horticultural history is there greater need than at the present, for a closer cooperation of effort on the part of state officials among themselves, and with the Federal Government, for the protection of horticulture and agriculture. Agitation in various lines of inspection service toward closer uniformity in state laws governing materials which must pass eventually into interstate commerce, is becoming more and more general and mandatory, in order to insure the optimum conditions for interstate movement of such materials. This applies to the inspection of seeds, feeding stuffs and fertilizers, insecticides and fungicides, and materials of other types used for agricultural purposes, and produced by agriculture.

Several years ago a bill was drafted, covering practically all the phases of horticultural inspection which might be concerned in state inspections. This bill was approved by the National Association of Nurserymen, and by this organization, with the hope that the bill might be used as a model, and adopted wholly, or in part, in so far as local conditions permitted,

by those states contemplating new legislation, or changes in their existing legislation. Several states have already adopted this bill wholly, or in part, and experience has proved it to be sufficiently complete and fundamental for all ordinary purposes. This bill is to be commended to those who are contemplating alterations in their horticultural inspection laws.

The horticultural inspection service of our states at the present time varies too greatly in efficiency and thoroughness—to such a degree that it is questionable whether it is right and proper in some instances to reciprocate in the acceptance of certificate licenses. These conditions are caused by various inadequacies, some of which could be remedied by greater effort on the part of state officials.

One of the prime reasons for faulty inspection in certain states is the insufficient financial support whereby an inadequate force of trained men is employed during the inspection period. The fact that one state containing a considerable number of nurseries may be so unfortunate as to overlook a serious pest within these nurseries, due to lack of funds for sufficient inspection officials, and lack of time as a consequence, may permit its multiplication and distribution of the pest to other states. The state officials in such cases are not always to blame, but much of the blame for these conditions should be placed on the nurserymen of the state, whose lack of interest in their own business welfare, and that of others in similar pursuits, obtains in their failure to secure adequate appropriation to support the work. We have before us at the present time an enormous problem with the very dangerous and serious Gipsy moth, which has multiplied enormously in certain state nurseries, and probably has been shipped to many points within that state and other states. Although this condition is most deplorable, yet the entire blame cannot be laid on the officials who are charged with the inspection, but some of it should be charged to the nurserymen's association of that state, which has shown but little activity in past years in attempts to secure adequate appropriations for the safeguarding of their own interests.

Moreover, careless systems and methods of inspection, or almost total lack of system, combined with a force of untrained or inefficiently trained and experienced inspectors, has brought about a most deplorable condition in some states. I can speak frankly of the woeful condition, and lack of system and accuracy in the nursery inspection work in my own state, previous to 1917. In this particular instance, it was not due to lack of funds, but to a lack of system and trained inspectors, which served to perpetrate a wholly unsatisfactory and inefficient nursery inspection system. Are there not other states at this time, where, to a

degree at least, such conditions occur, that might be remedied by definite and determined action on the part of the state officials? Efforts should be made by every honorable means to secure adequate appropriations to be handled wisely, judiciously, and effectively, to better the horticultural inspection service.

The Federal Inspection Service

Ever since the establishment of the Federal Horticultural Board, and during its activities, even to the present day, there has been in evidence varying amounts of definite and distinct opposition on the part of growers. In other words, the Federal Board has passed through, and is passing through, those stages and degrees of opposition with which the state officials have had to contend in the past two decades. It can be said, however, that much of this opposition has been engendered by a coterie of individuals in the florist and nursery business, many of them interested in the importing of foreign plants. In some of these attacks on the Federal Board, which have appeared in various floriculture and horticultural magazines, the writers of various articles apparently have been blind to the facts, or have ignored the actual truth, or treated it lightly in their statements. The members of the Federal Horticultural Board have been the victims of not only professional, but personal attack, almost entirely without warrant, because there is yet to be heard a single justifiable argument or reason why the Federal Board, or any member of it should seek in any way to bring disaster upon horticulture in this country.

Much of this opposition to the Federal Board in the past has been of a desultory nature, arising from various sources, appearing at inopportune times and places, and with an almost utter disregard of facts. At last there has been organized a committee, which proposed to delve into the facts of Quarantine 37 and its regulations, and this committee after a meeting in New York, prepared a preliminary report, which was sent broadcast over the country, and was printed in several magazines.

In justice to the Federal Board certain phases of this report should be discussed before this body, including corrections and denials of the committee's statements. First of all, unfortunately, this committee report is so drawn that an impression is conveyed to the public which is not warranted by facts. The statement appears that the quarantine has acted as an embargo, preventing the importation of any plants or seeds, except those permitted by narrow and seemingly arbitrary ruling. As a matter of fact, the great mass of plants imported, such as bulbs and fruit stocks, rose stocks, and similar material, have constituted the bulk of foreign importations, and it should be made clear that the forwarding

to Washington for examination, and possible fumigation, is best accounted for by the poverty of the Board, which is financially unable to establish adequate port of entry inspection, which they have been willing to carry out, and will carry out, if sufficient funds are granted for it.

The committee report seems to promote the argument that Quarantine 37 "will create in America a horticultural and floricultural desert," and will prevent America from securing any of the new creations of plants from foreign countries. The wording found in the committee report leaves the above impression with the reader. There is no "Chinese wall plant policy for America" under the present system of quarantine and regulations, and any statements to this effect are unsupported by facts. The committee also reports that the work of botanical gardens has been either stopped, or disastrously checked, in so far as their research operations are dependent on plants obtained from foreign countries. When it is known that the liberal use of permits totaled more than five hundred to date, covering a period of about eighteen months, and that these permits included permission to import bulbs, ornamentals, orchids, roses, and other herbaceous plants totaling nearly eleven million plants, the fallacy of these statements can be realized. The policy of the Federal Board, on the whole, has been decidedly liberal in the interpretation of the quarantine and the regulations promulgated under it, so that although certain limitations and handicaps are placed on miscellaneous plant importations, there is little doubt in the mind of trained entomologists and plant pathologists that many potential pests will be barred entry into this country.

The application and enforcement of these quarantine measures will in the end have a beneficial effect on the great horticultural interests of America by encouraging them to produce or grow their own material, create and control to a large degree their own market and prices, and ultimately there will come a period when our horticulturists will endeavor to produce by their own efforts many of those finer creations which are so easily obtained from Europe by the exchange of American gold for European horticultural effort. A field will be opened up which will encourage young well-trained plant propagators to exert their effort, unhandicapped by the sudden importation of large quantities of new creations from abroad.

Every conscientious effort of the Federal Board to restrict the entry and establishment in this country of foreign plant enemies, and every effort made by them to restrict the spread of plant enemies already established in America, should receive the heartiest support and cooperation of the state horticultural inspection officials. It behooves the latter

group at this time to use every legitimate effort to offset the attempts of the enemies of Quarantine 37, who are putting forth a united effort at this time, to hamper the Federal Board, and to curtail its power. Every state horticultural official should keep in touch as closely as possible with the hearings, decisions, and actions of the Federal Horticultural Board, and should extend aid, cooperation, and sympathy wherever possible.

Now that Quarantine 37 is established as a law, and since it is the authority for which we have long been striving, no opportunity should be overlooked for maintaining the present quarantine law, and upholding its prompt and rigid enforcement.

CHAIRMAN SANDERS: The next paper on the program is along a somewhat similar line to that I have dwelt on in the latter part of my paper, and I will call on Dr. Marlatt at this time to speak on the "Recent Work of the Federal Horticultural Board."

MR. C. L. MARLATT: Mr. Chairman, ladies and gentlemen: I am very glad that your presiding officer, Mr. Sanders, has taken up the cudgels in defense of the Federal Horticultural Board. It relieves me of the necessity of saying very much about quarantine 37. The work of the Federal Horticultural Board covers such a number of items that the mere listing of them would occupy the fifteen minutes assigned to me. I shall, therefore, discuss some of the more important features only.

During the past year, the Board had its powers enlarged. They haven't been curtailed in any particular since the original passage of the Act, but there have been several amendments enlarging its powers. The one of the last year added a section giving power of control of plants and pests for the District of Columbia, such as is exercised by the different States, and action has already been taken under this power.

Another large addition to the work of the Board has been the extension of the Port Inspection Service. Under the increased appropriation of last year, some seventy-six thousand dollars, we have opened port inspection offices at New Orleans, Seattle, and some other ports, and have very much increased our service at the older ports where the main entries are made, namely, New York and San Francisco.

We are asking this year for another increase of $50,000 to still further extend this service, and more particularly to make provision for an equipment of scientific, technical men and laboratories for the inspection of imported plants at the ports of entry instead of at Washington. As Mr. Sanders has just said, the need of such port inspection applies largely to the so-called prohibited plants that come in under special

permits, but with respect to such plants we have issued permits for some fifteen million during the eighteen months of the quarantine. Those opposing the quarantine say that we have created a Chinese wall and this is going to be a desert country so far as new plants are concerned, but over fifteen million of those plants have been authorized entry. We have a well-equipped inspection force of entomologists and pathologists at Washington, but we have not had funds to establish similar forces at other ports of entry. We have, however, provided for inspection at San Francisco to avoid the necessity of having shipments cross the Continent and back again, where the plants are to find their final lodgment in some Western State.

This Port Inspection Service is one of the big things that the Board is developing, and it is under the direction of one of our most efficient men —Mr. Sasscer—who is one of your officers and who will probably tell you something more about it later.

The new quarantines during the year—I see a list of some nine here—show some activity in the line of placing further restrictions on entry or movements of plants and plant products. In addition to these, two or three others have been prepared but have not yet been issued.

I will simply read the list to give you an idea of the additions during this year.

Foreign quarantines include the flag smut and take-all quarantine on account of which the importation of grains is restricted.

The Mexican corn quarantine is to prevent the entry from Mexico of cotton seed and the pink bollworm with corn.

The European corn borer quarantine is one which you are familiar with. It may, however, be of interest to you to know that we have had to amend that quarantine to include brooms—manufactured brooms. Certain shipments of corn brooms from Italy when examined were found to contain whole stems of broom corn in the filling of these brooms. It was perfectly patent that it was possible to have insect pests come into this country through the agency of such manufactured brooms. These brooms were held up and after trying various other methods they were steamed. I may interject here that heat beats all other disinfectants. When you cook a worm once it is dead; you don't have to wonder whether the "insecticide" was strong enough or not!

The domestic quarantine on account of the European corn borer was revised to cover the extension of this pest determined in Massachusetts, New York, and Pennsylvania.

The Japanese beetle quarantine has been enlarged.

In the case of the moth quarantine, the brown-tail moth has been killed out by various agencies as indicated by Mr. Burgess, and we were actually able to reduce the area under quarantine.

The Mexican bean beetle quarantine is one which has been drawn and is now being held in the hope that we will get from Congress $150,000, a good portion of which will be for the enforcement of a regulated quarantine. If we don't get that money, in the absence of any State money, we will have to put on an absolute embargo to be enforced through the agency of the common carrier and through the cooperation of the officials of Alabama and surrounding States.

The pink bollworm quarantine in relation to Texas and Louisiana I will discuss a little later.

We have also issued a quarantine with respect to Porto Rico applying to Porto Rican cotton, and at the same time, revised the cotton quarantine in relation to Hawaii.

An important quarantine which lies on my desk and has not been completed for lack of time, because it involves a lot of consideration, is the first of a series perhaps which will require the cleaning at the point of discharge of load of railway cars which have conveyed and are fouled with plant products. I think this is one of the most important subjects that we have before us.

The Board is advised that it has no authority under the law to have a quarantine declared of the whole United States with regard to the whole railroad system, requiring such cleaning of cars, but that under a showing of some definite danger in a specified district such cleaning could be required as to such district, and we are preparing as the first try-out in that direction the requirement of the cleaning of cars that originate in the cotton states. There really ought to be a law, requiring all common carriers to thoroughly clean and disinfect cars at the time and place of discharge of loads as a condition of subsequent interstate movement. It would save a lot of distribution of pests.

Altogether we are now enforcing some ten domestic quarantines, eighteen foreign quarantines, and ten restrictive orders.

In addition to the administration of these numerous quarantines, we have the administration of some big projects; for instance, the importation of all foreign cotton, the pink bollworm control, the potato wart problem, and other problems of that kind.

I discussed this morning the cooperation of the Board in the administration of these quarantines with the related bureaus in the Department. Briefly, the quarantine administration and control comes under perhaps three classes: First, direct, where the Board is fully authorized by Congress to do all that is necessary to be done. That does not mean we don't cooperate even in these quarantines. Examples of these are the pink bollworm and the potato wart projects—one in which we cooperate with the Bureau of Entomology and the other with the Bureau of Plant Industry.

A second class is in relation to funds appropriated by Congress but without reference to a Bureau or office, but referred by the Secretary of Agriculture to joint control of the Board and the appropriate bureau. The corn borer appropriation (1920) is in this class.

Then we have a third class where the funds are definitely appropriated to the bureau or office and the quarantine feature comes under the cooperative control of the Board. There is quite a long series of these—the gipsy and brown-tail moth, wheat smut, pine blister, and Japanese beetle are examples. If we totaled the funds appropriated for all this quarantine and control work it would probably exceed $2,000,000.

The two big interesting problems of the year are the pink bollworm work in Texas and Louisiana and the South, and the administration of plant quarantine 37.

I think that at the last meeting of this Section I reported rather hopefully on the pink bollworm situation. Unfortunately, about that time, or a little thereafter, the insect reappeared in the old district in southern Texas and was discovered also in Louisiana. I think the details of those discoveries are probably familiar to all of you. This development led to a very large amount of activity on the part of the Board—getting extra funds from Congress for cleanup work and getting action and legislation from the States of Texas and Louisiana.

I wish every State in the Union in the presence of an emergency like the appearance of the pink bollworm in Louisiana would take the same sort of enthusiastic, thoroughgoing, heroic action which the State of Louisiana took. The State enacted laws giving full authority and appropriated $225,000, and has carried out the program, which is even more important.

Texas was laggard, I regret very much to say. The Secretary of Agriculture became very much interested in the matter. We had conferences in Washington which were addressed by the Secretary of Agriculture, and finally at the request of the Governor and of the Legislature of Texas the Board went to Austin, Tex., and remained there for a considerable period to aid the Legislature in enacting a suitable pink bollworm law. Unfortunately, due to active opposition and consequent delay, the Legislature was not able to perfect the legislation and the law as passed has large defects. For example, it does not provide for immediate noncotton zones. Several such zones can begin only with 1921. It abandoned, by oversight I think, the border zone which had been established for two years. It limits destruction to fields of cotton actually found infested, and hence prevents regional destruction of growing, maturing cotton, and it requires further that any noncotton zones established shall be reestablished every year instead of continuing until the order is lifted.

In spite of these difficulties we have gone ahead with cooperative work in Texas, and the people of the State have given us such cooperation as practically to give the control which we would have had under an adequate law. Noncotton zones, of course, could not be enforced, but in point of fact nature came to our rescue as to the Trinity Bay district with a climate that was unfavorable over much of the area where we should have had a noncotton zone, and in effect produced such zone.

You will be interested in knowing our point of view relative to the outlook for extermination. We do not believe it is hopeless. The insect has not appeared at any new point in Texas except at El Paso. The old Trinity Bay district is very much smaller in its area of infestation than it was in 1917 and in 1919, and the infestation that has been found in it has been of a very scattering nature. In the two other districts in Texas where we have had the pest before, it did not appear at all in 1920, namely, the Pecos Valley and the Hearne districts.

In Louisiana there has been no reappearance in the three parishes and only one new point in the State—at Shreveport—and this has been vigorously taken hold of and will be noncotton next year.

We believe therefore that there is an opportunity still to exterminate the pink bollworm, We have now before Congress an estimate for an emergency appropriation of $100,000 to finish up the work of this year. We are also asking in our regular appropriation for about $660,000 for work for 1921–22.

There is a particular strength of argument which we can make with relation to these special appropriations. They are not like research work; they are not like educational work which, if not done, causes the public no irreparable harm; you can give that same demonstration, the same education another year! In the extermination of a pest like this, or like the citrus canker, you have the opportunity once and once only; if you let it get away you cannot take it up another year!

We have also a large Mexican border service on account of the pink bollworm. This subject is on your program for later discussion.

We have discontinued, for the time being, the research station in the Laguna, but what I think will be a very authoritative and interesting document is now going through the press, giving the results of the research there for the last two years.

Incidentally, one of the most important pink bollworm developments of the year has been the sending of a commission to the Laguna by the Governor of Texas—a commission involving in its personnel all the big cotton and farming interests of Texas,—brainy men who have large influence in that State. The sending of this commission was to determine whether the entomologists were magnifying the situation, and

whether the pink bollworm was really doing the damage charged to it. As a result of minute examinations this commission determined that the loss from the pink bollworm for 1920 was fifty per cent. of the crop. Their report to the Governor made a tremendous impression upon Texas and is going to help the whole situation.

The other large element of Board work is the control of plant and seed importations. Your Chairman, Mr Sanders, has helped me out very considerably in his discussion of this subject. This service is under the direction of Mr. Beattie, who will tell you more about it later. There are in the country large numbers of very estimable people, many of them of great wealth, who are interested in orchids and roses, and who are members of local amateur societies, garden societies, flower societies of all kinds, who have been seized upon by the small bunch of aggrieved importers and have had their souls filled with distrust of the Federal Horticultural Board and its works in relation to quarantine 37.

An informing statement on quarantine 37 has been prepared and will be issued shortly to make available accurate information relative to this quarantine.

In spite of assertions in recent propaganda, America will not become a desert, not with some 15,000,000 so-called "forbidden plants" authorized entry in eighteen months! The fact is that we authorized the entry of about four times as many as could be found abroad to purchase! You understand that this entry of foreign plants is not a violation of the spirit of the quarantine. These plants cannot be sold. These plants are permitted entry for the sole purpose of introducing new varieties and propagating stock and from such introductions to grow in this country new stocks,—American grown—which can be sold. In other words, we are developing in this country the production of the plants which we formerly imported.

This quarantine now has the general support of the commercial plant growers of the country. Many men come into my office who have been fighting the quarantine vigorously in the past, and after some hesitation it finally develops that what they are really interested in is, if the quarantine is going to stick, whether we have got backbone enough to stand up for it! They go away satisfied!

CHAIRMAN SANDERS: Your Chairman feels that he would have been sadly remiss if he had restricted Mr. Marlatt's talk to the fifteen minutes that was stated on the program, because there are only a few of us here who have the opportunity to frequently get in touch with the Federal Board and to be in attendance at the hearings and meetings, and I feel

that what Mr. Marlatt has given us today is extremely instructive as to the aims and objects of the Federal Horticultural Board.

The next paper on the program is by T. J. Headlee.

THE PRESENT STATUS OF THE GIPSY MOTH IN NEW JERSEY

By THOMAS J. HEADLEE, Ph.D., *State Entomologist, New Brunswick, N. J.*

One year ago it was thought that New Jersey did not entertain the Gipsy Moth within her borders just as many other states in this country now believe that they are not acting as hosts for this insect. In July 1920 caterpillars of the Gipsy moth were found feeding upon both evergreen and deciduous foliage within the limits of Duke's Park near Somerville. It was evident from the outset that the infestation was of long standing and probably large. Mr. A. F. Burgess, in charge of the Moth Control Service for the United States Government was promptly invited to meet the New Jersey authorities and to examine the situation. Messrs. Burgess, McIntyre, Weiss and the writer went to the Somerville district on the arrival of the two above gentlemen first mentioned, and after a cursory examination of the situation, during which Mr. Burgess discovered a vigorous specimen of *Calosoma sycophanta*, sat down to plan out the procedure.

Logically it seemed that the first thing to be done was to find out the extent of the local infestation and the second thing was to find out whether the Duke Farms Company had disposed of any of its surplus trees, where in the park area such disposal may have originated and where such material as had been disposed of had been sent. Mr. Burgess agreed to send into New Jersey some of his trained gipsy moth scouts to make a preliminary survey, and Mr. Weiss agreed to look into the business relations of the Duke Farms Company relative to the question of sending out surplus stock.

Accordingly the gipsy moth scouts made their appearance a couple of weeks later, and before they had finished with the Somerville area determined that at least ninety (90) square miles were scatteringly infested. It seemed that the center of the infestation lay in a thirty acre block of blue spruces. Inasmuch as these spruces were imported not less than ten or more than twelve years ago from Belgium and Holland it seemed likely that the infestation was brought over with the blue spruces at that time. Owing to the relatively unfavorable nature of the spruce foliage the insect had been a number of years in getting sufficient start to move out of the spruce. Furthermore, the egg masses were darker colored than those found in New England and this fact supported the belief that the infestation originated in Europe.

Mr. Weiss investigated his phase of the problem and furnished to Mr. Burgess as complete a list as could be secured of the business done. It should be understood at this point that the Duke Farms Company is not essentially a nursery concern; but constitutes the management of the personal estate of Mr. James B. Duke, developed for his pleasure and that of the public. The trees in the plantings were set close together, in order that in spite of natural losses there should still remain an adequate stand. As a matter of fact the stand proved more than adequate, and as the trees grew it became necessary to remove a considerable number from time to time and plant them elsewhere on the estate, burn them up or sell them. The first and third types of action were adopted by the Duke Farms Company and in 1913 they applied to the New Jersey Inspection Force for a certificate permitting them to ship.

Mr. Weiss procured apparently a list of the shipments of surplus stock that had been made and turned that portion of the list which was concerned with shipments outside of the state to Mr. Burgess for further action. Mr. Burgess then, furnished the officials of the various states with a list of the shipments that had gone into their states. In such states as did not have the men to follow up these shipments he sent his own scouts. Mr. Burgess further furnished some of the personnel of the force which scouted the points to which shipments from the Duke Farms Company had gone intrastate. In the course of the scouting of sections to which shipments had gone intrastate slight and recent infestations were found at Glen Rock, Wyckoff, Paterson, Elizabeth, South Orange, Mendham, Scotch Plains and Deal Beach. The egg masses in these outlying points ranged from one to nearly eight hundred. In all cases where egg masses were found in the outlying districts by the scouts they were treated with creosote.

At the writer's request Mr. Burgess called a meeting in New York on August 24th (before the Glen Rock, Paterson, Scotch Plains and Mendham infestations had been found) to which were invited Mr. J. G. Sanders of Pennsylvania, Mr. George G. Atwood of New York, Mr. Weiss of the New Jersey State Department of Agriculture and the writer. The writer took occasion to invite the Secretary of the New Jersey Department of Agriculture, Mr. Alva Agee, and the Director of the New Jersey State Department of Conservation and Development, Mr. Alfred Gaskill. At this conference an estimate of the funds needed to combat the gipsy moth infestations in New Jersey, New York and Pennsylvania on an exterminative basis was considered. Mr. Sanders reported that he had destroyed the infestation, root and branch, on the Schwab estate and that in all probability no funds, other than those provided by the State, would be needed in Pennsylvania. Mr. Atwood's

representative did not feel the same way and seemed to desire some government aid. Mr. Burgess indicated that already the United States Gipsy Moth appropriation was $150,000 shy, and New Jersey stated that the proposition in that state was sufficiently large that government aid would be most decidedly welcomed. Briefly stated the budget as prepared to combat the insect on an exterminative basis for the first two years was as follows:

To June 30th, 1921—New York $50,000; U. S. Government $150,000; New Jersey $100,000. In addition to the exterminative work in New York and New Jersey, the United States authorities decided to ask for $150,000 to supply the deficiency on the gipsy moth work in New England, making a total request on the part of the United States of $300,000 and on the part of the states of $150,000.

To June 30th, 1922—New York $50,000; U. S. Government $200,000; New Jersey $100,000. In addition to the request for exterminative work the United States authorities decided to ask for $400,000 for the suppression work in New England.

The total government request for the fiscal year ending June 30th, 1921, as set forth in this conference was $300,000 and the total for the fiscal year ending June 30th, 1922 was $600,000. The total New York request for the fiscal year ending June 30th, 1921, was $50,000 and the total request for the fiscal year ending June 30th, 1922 was $50,000. The total New Jersey request for the fiscal year ending June 30th, 1921 was $100,000 and the total request for the fiscal year ending June 30th, 1922 was $100,000. It was understood that, as far as the relation between the United States authorities and the New Jersey authorities were concerned, $100,000 of the appropriation for the fiscal year ending June 30th, 1921 was to be available for work against the New Jersey infestation, and it was also understood that during the fiscal year ending June 30th, 1922 another $100,000 of the government appropriation should be available for work against the New Jersey infestation. It was decided that outlying infestations in New Jersey could be cleaned up in two years, but that the Somerville colony would require five years, and that state and government should be requested to finance the last three years on a fifty-fifty basis.

After the writer had time to think the matter over thoroughly, he decided that, in view of the problem of exterminating the outlying infestations and in view of the fact that many of the large estates within New Jersey's limits had never been scouted and, in view of the further fact, that these estates were probable sources of danger, further provision should be made for exterminative work against the outlying areas and for the scouting of the large estates and such other danger points as

might be thought advisable. Accordingly, instead of requesting the Legislature at its meeting on November 8th for the sum of one hundred thousand dollars, he requested the immediate appropriation of the sum of one hundred and twelve thousand dollars. He is happy to report that the bill was introduced, passed by both houses and signed by the Governor within less than seven hours; the money thus appropriated becoming immediately available. He plans during the months of January and February to request the Legislature of New Jersey to appropriate the sum of one hundred and twenty-five thousand dollars for the fiscal year beginning July 1st, 1921, and ending June 30th, 1922. This extra twenty-five thousand dollars is planned for supplementary exterminative work against the outlying infestations and for the scouting of the large estates and other danger points.

In addition to the above appropriation, Mr. J. B. Duke, being familiarized with the nature and the extent of this infestation before the state appropriation was made, agreed to make available private funds to the amount of twenty-five thousand dollars. This action was a most welcome one for it was felt that a thorough dormant season scout would reveal a greatly increased area of infestation in the Somerville district.

Since the securing of the funds from the State Legislature another infestation has been discovered at Mendham. The egg masses here almost exactly correspond to the masses found in New England. Neither the size nor the origin of this Mendham infestation has been determined.

Early in the consideration of the exterminative work against the gipsy moth in New Jersey, Mr Burgess informed the writer that by December 1st, all government moneys available for work against the gipsy moth in New Jersey would be exhausted, and that no further funds could be provided until the meeting of Congress in December. Furthermore, Mr. Burgess pointed out that spraying machinery for the spring work against the gipsy moth would have to be ordered very promptly, or it would not be ready in time for next spring.

Beginning previous to December 1st the New Jersey State Department of Agriculture began to take on its pay rolls a large number of gipsy moth scouts and foremen, who were drawn from the New England forces. Crews were located in the Somerville area and at various outlying points. Mr. H. A. Ames was designated by Mr. Burgess and Mr. McIntyre as a satisfactory man to take general charge of the work. A central office has been established at Somerville, and Mr. Ames has been permanently located there. At the present time there are about eighty gipsy moth scouts working in the state, of whom fully two-thirds are experienced men drawn from the New England forces and officered

by foremen, general foremen and an executive from New England. About one-third are New Jersey men, who are learning the work of scouting for the egg masses. Arrangements have been made to purchase eleven new high powered truck mounted sprayers for use during the coming spring.

For the protection of other parts of the state and of other sections of the United States, the entire Somerville area has been included in a quarantine, which covers something like 200 square miles, and this quarantine is being administered in conformance to the plan governing the same sort of work in New England, and is being endorsed by Mr. Ames and the group under him. Furthermore every point at which infestation has been found has been placed under a similar quarantine, which is being conducted in the same way. While these quarantines are intrastate in character, by reason of the source from which they came, they are operating also as interstate quarantines.

Thus it appears that the New Jersey infestation of the gipsy moth is being attacked upon an exterminative basis and that a determined and well considered effort is being made to prevent infestation passing from the areas already infested into uninfested portions of New Jersey and into other states. This problem would not have been attacked on an exterminative basis, were it not for the fact that the New Jersey authorities were assured by Mr. Burgess and his aids, after they had been carefully over the territory, that extermination was entirely a practicable matter.

In all this effort against the gipsy moth, the Japanese beetle has not been forgotten, and it is expected that the Laboratory working for the control of this insect will be adequately supported by the United States Government and the States of New Jersey and Pennsylvania.

The discovery of an injurious insect, such as the gipsy moth, within the limits of any state does not, it seems to the writer, constitute a justifiable basis for criticism of the force operating in that state; but rather should be taken as an evidence of activity on the part of that force. Such a discovery becomes a justifiable basis for criticism only when the inspection force is adequate to meet the situation, and there are few inspection forces in any of the states in this country which are adequate. Something like six or seven years ago the writer proposed, at a public meeting of the New Jersey State Department of Agriculture, the appropriation of funds to institute and to support an insect scouting and survey service with the idea that the large estates of New Jersey should be combed and that any other danger points should be very carefully examined. This suggestion received little attention and came to naught as has been the fate of other efforts of a similar kind in other parts of this

country. It seems that a severe epidemic of some kind is necessary to induce the people of our democracy to extend adequate support to preventive organizations and measures. In this connection the writer would like to point out that California's inspection service is the result of a fear that the citrus industry would be wiped out, and that Florida's efforts are the natural and normal result of the fear that its citrus industry would be destroyed by the citrus canker. He anticipates that this severe experience with the gipsy moth will lead the citizens of New Jersey to support a twenty-five thousand dollar insect and disease survey service; thus putting New Jersey in a position to protect herself against the establishment of serious insects and diseases in so far as such action on the part of the state is humanly possible.

In view of the acknowledged insufficiency of our present inspection service in most of the states of this country, and in view of the fact that about the number of years necessary for infestations, established ten or twelve years ago, to make their appearance, and in view of the further fact that a well supported insect and plant disease survey service affords the greatest practical measure of protection, it seems to the writer that every state should make a determined effort to put on and maintain an insect and plant disease scouting and survey service, which is at least approximately adequate. It is now just about ten years since the period when the gipsy moth egg masses came to this country in immense numbers, and it is entirely probable that far more infestations of this insect have become established than any of us dream of.

CHAIRMAN SANDERS: I am sure we are glad to have this authoritative statement by Mr. Headlee on the present conditions in New Jersey.

MR. BURGESS: If there is an opportunity to discuss this I would like to make a supplementary statement. There have been found in addition to what Mr. Headlee has indicated, four infestations in New York State. Three of these are on Long Island, and one in the Hudson Valley. Stock from that estate was shipped to the Park Department in the city of Buffalo, and the trees were used for resets on the street to replace trees that had died, and it has been necessary to scout the city of Buffalo in order to determine that infestation had not made a start in that city. That work has been done by men on the Bureau force. Work of a similar character should be done in Brooklyn and in other points in New York State. I would like to call attention at this time to the financial situation in connection with the gipsy moth project. Last year I told this Association that the gipsy moth situation was extremely critical and that with the $300,000 appropriation which we had ordi-

narily received we would not be able to do the work that should be done in New England. We asked for $400,000. We received $250,,000 and in addition to that, shortly after the first of July, we also learned of the large infestation in New Jersey which made the problem extremely difficult, to say the least. Dr. Headlee has indicated what has been asked for in the way of appropriations: $300,000 additional money for the present fiscal year, that is from the present time up to the first of July; and $600,000 for the following fiscal year.

The estimates were approved by the Department of Agriculture. An emergency bill was drawn for the $300,000 and is being considered by Congress at the present time. The funds for field work are exhausted with the exception of a few thousand dollars, and practically all the field men are either being carried on the New Jersey, Connecticut, Massachusetts or Vermont pay rolls. This condition cannot last very long and unless the emergency appropriation is made available very soon, we are going to have extreme difficulties a little later in the season.

Under present conditions we are not in a position to contract for the necessary equipment or poison for spraying work in the Spring, and the situation is indeed very serious. I think all of you will be glad to know just what the condition is with respect to the gipsy moth problem at the present time.

CHAIRMAN SANDERS: Your Chairman will take this opportunity to appoint a Nominating Committee who will select a Chairman for this Section, also a Secretary, the Chairman who is to be approved by this Section for final election as third Vice-President of the American Association. I appoint Mr. Dietz and Mr. Cotton to serve, and I will ask them to be ready to report at the end of the program.

The next paper on the program is by O. D. Deputy, to be read by Mr. Sasscer, and illustrated with lantern slides.

ACTIVITIES OF THE FEDERAL HORTICULTURAL BOARD ON THE TEXAS-MEXICAN BORDER

By O. D. DEPUTY, *Laredo, Texas*

The placing of an actual inspection force on the Texas-Mexican Border by the Federal Horticultural Board was begun late in the spring of 1917, it having been previously determined that there was Pink Boll Worm infestation in the Laguna district of Mexico and that seed from that locality was being brought to the border for exportation to the United States. For the needs of this paper it will suffice to say that a ban was immediately put on all cotton seed from Mexico and that an inspection force was shortly recruited whose main duty it was to keep all such

seed out of this country. Incidently, there were other quarantines against other Mexican products that were to be enforced. In order to accomplish this multitude of duties, it has been necessary to inspect all passenger traffic and the baggage pertinent thereto as well as all railway cars, fumigating a large percentage of the latter.

The inspection of the railway cars from Mexico had to be performed in Mexico because the functionings of the Mexican and American Customs Departments are such that, when once a car has crossed the international boundary, it is supposed to have legally entered the country, and the regression of the same is nothing short of the work of a day. The initiation of this mode of inspection was an onerous task, indeed, and many a wrench was thrown into the machinery of inspection by uninformed Mexicans who could not understand why the entry into the States of a few stray cotton seed in the cracks of railway cars should be objected to; nor could they see by what manner of logic we could presume to make such inspections in Mexico. So presumptuous did the men performing the work appear to them and so odious the requirements of the regulations that they straightway gave the men engaged in the same the name "Picudo," meaning in Spanish according to their application, "long nosed, nosey individual." Nor was this the only indication of a lack of co-operation for the American shippers were of the mind at first that the inspection was too exacting and that the regulations were too stringent. Finally, however, by diligently explaining the need for the inspections and by fair treatment of each case according to its merits, the inspectors caused the work to gradually gain in favor, until now it is indulgently tolerated if not particularly sought after.

The inspection of a car is after all a dry matter-of-fact proposition that does not readily lend itself to a colorful, attractive description. In a word it consists of jumping into the door of a car and looking into all of the available cracks for cotton seed. But surprising it is how adept the men become at finding, in a short time, all of the cotton seed contamination that a car contains. Adept they must be too when it is remembered that at times it falls to the lot of one man to inspect as many as ninety cars in a day. Disposing of an empty car is a comparatively easy task for it is either free from contamination and is certified to cross or else it is fouled with seed and entry is prohibited until such a time as the shipper has had it cleaned to the satisfaction of the inspector. It is not until cars containing cargoes are found to be contaminated with cotton seed that difficulties are experienced. If such a car containing ixtle, lead, beer, or other such free shipping article, transferring the same under supervision is a small task. On the other hand, if the cargo happens to be bulk material such as ore, bone, or bat

guano and it is found to be fouled, it becomes necessary to devise such a procedure as will reduce to a minimum the possibility of any cotton seeds passing into the United States when the load itself is permitted to enter. In the case of ore it is thinly spread, saturated with oil, and burned over; bones are sprayed with oil; while guano, if fine enough, may be screened.

That the inspection of cars might be carried to a successful termination, it has been found expedient that there be a certain amount of paper work connected with its execution. To fill this need a car record card has been adopted which shows on the face of it where the car came from, its ultimate destination, whether it is inspected or not, its condition at the time of inspection, and if the car has entered the United States. Under the conditions which the work operates this information is indispensible and, having the same, the inspectors are assured of keeping a tight rein on the movement of cars out of Mexico.

Before the subject of car inspection is left it might be well to mention that no less than a third of all cars inspected are found to contain cotton seed and that in numerous cases live Pink Boll Worms have been found in seed taken from such cars. The latter statement is particularly applicable to the ports of Laredo, and Eagle Pass, Texas. This in a word comprises the work done in Mexico.

From the very outset the Board required the fumigation of certain cars. At first pot fumigation was practiced and two ounces of sodium cyanide per hundred cubic feet of space were used, but later the dosage was reduced to one and one-quarter ounces when the cars were fumigated in the fumigation houses which the Board put into operation October 1, 1919. The erection of these houses was largely due to the untiring efforts and enthusiasm of Professor R. Kent Beattie who drew up in their entirety the plans for the houses. These buildings which were made of brick were so constructed and their doors fitted with such an exact nicety, that one car or a number of cars could be placed therein and the compartment containing the same would be practically air-tight.

On one side of the house is an auxiliary room where the gas is manufactured. The machinery used in the generation of this gas is simple in design. For the sake of clarity it may be described as consisting of three tiers of tanks; the first of which is composed of an acid drum and two large tanks for stock solutions of sodium cyanide; the second is comprised of measuring tanks for the cyanide solution, acid, and water that they may be introduced into the generators in the proper proportions; and the third tier consists of the generators proper in which the gas is generated and from which the gas goes to the various chambers

of the house. All of the generators, measuring tanks, and storage tanks are inter-connected by pipe manifolds so that, if one of the various pieces of machinery composing the battery becomes incapacitated, another may be substituted for the same.

There are four fumigation plants at the several border points: one at El Paso with a capacity of fifteen cars, another at Laredo with the same capacity, while those at Brownsville and Eagle Pass are smaller, they permitting the fumigation of six and eight cars respectively. At Del Rio such a house as will accommodate vehicles is maintained. All told, it is now possible to fumigate on the Texas-Mexican Border two hundred and fifty cars a day in these houses. Although, owing to the subnormal conditions in Mexico, only about 15,000 cars are fumigated per annum, the houses have an annual fumigating capacity of 60,000 cars.

To carry on fumigation even on a 15,000 car per annum basis requires large quantities of sodium cyanide and sulfuric acid. At present some eighty or ninety tons of cyanide and ten or twelve cars of acid are consumed yearly. To meet all expenses covering supplies, labor, and miscellaneous materials incidental to fumigation, a self-sustaining feature has been introduced into the work, in other words, the cost of fumigation is assumed by the Department of Agriculture but a charge is made to cover the actual labor, other than supervision, and the chemicals used. At first the fee for each car treated was five dollars but later, owing to the elimination of wastage and the reduction of labor required, this fee was reduced to four dollars. It is altogether possible that further reductions in the cost of operation may be made. In fact, there is a concerted effort on the part of everyone connected with the work to practice every economy in keeping with good business that this service may be rendered at the least possible cost to the shipper.

Another problem presented itself for the consideration of the Board when in the early part of 1920 Mexico commenced to export huge quantities of corn. Ordinarily the conditions are reversed and large shipments of corn are imported into Mexico but in 1920 the corn crop had been especially large and high prices prevailed in the States; hence, this unusual movement of corn out of the Republic. All of the corn was shipped already shelled and it soon developed that most of these shipments were fouled with cotton seed, the theory of contamination being that the shippers in Mexico had stored the corn in the same bins that they had previously used for storing cotton seed. It was impossible to eliminate this contamination by mechanical means and it became necessary to prohibit the entry of the corn unless certain conditions were met. These conditions were that, either the corn be ground to fine meal or that it be sterilized by heating it uniformly to a tempera-

ture of 200 degrees Fahrenheit for five minutes. In either case the work was to be done under the supervision of an inspector of the Board. None of the corn was ground but sterilizers for treating it were installed at El Paso, Laredo, and Piedras Negras, opposite Eagle Pass. The machine at Piedras Negras works on the theory of exposing the corn to currents of air which have been previously heated by passing them over a core of steam pipes; while the machines at Laredo and El Paso function on the principle of heating the corn by exposing it to confined steam. Through the above agencies a much needed product was allowed entry into the United States without endangering in any way the agricultural pursuits thereof.

The last but in no way the least important or interesting duty which has evolved itself on the shoulders of the Federal Horticultural Board is the performance of the foot bridge and passenger inspections. The one takes place at the footbridge and pertains to local resident people and tourists who go back and forth between the towns situated on either side of the boundary; while the other, the passenger inspection is confined to travelers from the interior of Mexico. The latter work is relatively simple because there is no attempt ordinarily to conceal, hide, or smuggle prohibited material. It is mainly through ignorance on the part of the traveler that quarantined products are offered for entry. Nevertheless, it has been proved that this ignorance might have been the means of adding more trials to the already many agricultural tribulations of the United States had not inspection been practiced. It is recalled that on one occasion some ninety weevil-infested avocadoes were confiscated from a tourist who was taking them to California to experiment with growing Mexican avocadoes in the avocado growing section of that state. On several occasions numerous live Pink Boll Worms have been taken from immigrant passengers who were using seed cotton for filling pillows. These are only a few classical examples; there is never a day that many confiscations are not made.

The local footbridge traffic is quite a problem. The greatest offenders are the Mexicans who live on the American side or pioneer residents who have developed a seemingly unmanageable appetite for Mexican fruits. They may be likened to an ungovernable child and the inspection at the footbridge resolves itself into a contest of matching wits with them. In some cases where attempts to smuggle have been made, some rather unique methods of concealment were resorted to. On one occasion a party of four women presented themselves at the foot bridge. For some reason their deportment excited the suspicion of the Customs Inspectress, who detained them. No prohibited material was found in their hand baggage, but when their clothing was searched two cloth bags,

of such a shape and size as to be easily concealed, were found about the waists of two of them. These bags contained a total of twelve avocadoes and three mangoes. On another occasion a Mexican woman, who had been stopped, proved herself so undependable when questioned, that the inspector on duty persuaded himself to break open what appeared to be a perfectly normal loaf of bread. It contained several avocadoes. The woman had gone to the trouble to bake a thin crust of bread around a small number of avocadoes. Then there are the old and often tried practices of hiding prohibited material in the pockets, under a large sombrero hat, or concealing it in the pockets or under the seats of automobiles and buggies. New tricks are constantly being tried, but these are good examples of the methods used and show how persistently people try to bring in material in violation of the law. At Eagle Pass an average of 1,500 passengers at the foot bridge are inspected each day; this average is increased to 5,000 at Laredo; while at El Paso the inspector at the footbridge has to supervise the crossing of some 10,000 persons daily.

There are in all at the different border ports, twenty-four Plant Quarantine Inspectors who are schooled in the various activities of the Federal Horticultural Board and each of the twenty-four is performing a signal service for the country at large.

CHAIRMAN SANDERS: The next paper is by Professor F. M. O'Byrne of Gainesville, Florida.

STANDARDIZED NURSERY INSPECTION

By F. M. O'BYRNE

There is almost constant agitation by the nation's nurserymen for a uniform nursery inspection law. The many varying inspection laws are confusing and troublesome. They feel that the laws should be so changed that the inspection provided in each state will be sufficient to carry plants from any state to any point in the Union.

While the advantages of such laws are obvious, I frankly despair of ever seeing them in force. Pests that are the most destructive in the South are often ignored in the North, and vice versa.

This does not mean that it is impossible to standardize nursery inspection laws the nation over. There are many conflicting requirements that can be eliminated.

The following suggestions, while not complete, will indicate points on which standardization is desirable:

1st. All inspection certificates in the United States should expire on the same date, probably September 30th.

2d. License fees, for nurseries both within and without the State, should be eliminated. License fees greatly increase the number of clandestine and illegal nurseries. To charge a higher fee to ex-state nurseries than to state nurseries is unjust and discriminatory.

3d. Fumigation requirements as to plants required to be fumigated, dosage, and time of exposure should be the same in all states.

4th. The question should be settled as to whether anything less than an inspection of every plant in a nursery will suffice for the issuance of a certificate. (We think it should not.)

5th. A list of plants that must be dipped should be agreed upon by all states, and the strength of the dip and the manner of dipping should be specified.

6th. All states should require a valid and unaltered certificate of inspection of uniform size and appearance attached conspicuously to the outside of each box or other container of nursery stock. To have such certificates uniform in size and appearance will enable the transportation agents to co-operate. Certificates of all sizes and wording, etc., make easy the counterfeiting of certificates. The Florida tag has proved satisfactory. It is printed on a No. 8 raw hide tag with a brass eyelet. The certificate is at the top; the space for the address is in the middle and the return address and shipping instructions of the nurseryman are at the bottom. Writing the name of the addressee or consignee on the tag is required. This cancels the tag and prevents its illegal re-use. We believe that the writing of the consignee's name on the certificate tag should be a uniform requirement.

7th. If any other marking is required on the package it should be the same throughout the states.

8th. Each state should make the same requirements of out of state nurseries that wish to do business within the state. It doesn't matter so much to the nurseryman what he has to do, provided the requirements are the same in all states.

9th. Quarantines should be standardized and should follow as closely as practicable those of the Federal Horticultural Board.

10th. Nurserymen should be required to purchase their certificate tags from their State Nursery Inspector. Each tag should bear a different number and the nurserymen should be required to account for each tag received by filing with the Inspector a

record showing how each tag was used. This record or invoice should give the name and address of both the nurseryman and purchaser, date of shipment, an accurate list of the plants shipped and the number of the certificate tag used thereon. In other words, an invoice. If, at the end of the season, it is found that the nurseryman has failed to account for any tags issued him, the missing records should be promptly called for.

This requirement is one of the most important. It should have a place in every state's inspection scheme. Nursery Inspection laws are for the protection of farmers and horticulturists. To protect themselves they secured the enactment of such laws, with the mistaken idea that a highly trained inspector could look at a tree and tell whether it was free from insect pests and diseases. The farmer and horticulturist want protection, and under the ordinary nursery inspection system they are neither getting what they want nor what they are paying for. Is this charge fair? Let us see.

This nation's nursery inspection laws were passed primarily to stop the spread of San Jose scale. Did they stop it? No; San Jose scale has probably been shipped under the certificate of every Nursery Inspector in the United States.

Consider the host of pests that have been spread on nursery stock in the last few years: fire blight, cottony cushion scale, white pine blister rust, Oriental peach moth, wooly aphis, crown gall, Japanese beetle, chestnut blight, citrus canker, and so the list goes. Citrus canker entered Florida on certified stock from two, and perhaps three different states and from Japan. It was passed, I believe, by Federal Inspectors. It was shipped all over our State on certified stock: proof that inspection alone, no matter how rigid, is insufficient. There are many reasons why inspection alone cannot give proper protection:

1st. A nurseryman has large sums invested in his business. If you find some pest in his stock you can't condemn it all whether you actually find it infested or not and require its absolute destruction. He would fight such a ruling in the courts and would usually win. You must compromise with him by arranging a fumigation, or some other such precautionary treatment—and then the pest spreads.

2d. An inspector is practically helpless when dealing with a new pest. He can not put on a blanket quarantine that will damage or ruin a nurseryman every time he sees a new spot; he must watch developments for awhile. If eventually he finds that it is a serious pest he knows, to his chagrin, that stock he has been certifying as apparently clean has been carrying that pest.

3d. It is impossible for an inspector to detect any disease in its incipiency. There is always an incubation period after infection when it is impossible for an inspector to tell whether the plant examined has the disease.

4th. Most of us will admit that we are unable to do our inspection work as thoroughly as we would like, because of lack of funds.

5th. Occasionally nurserymen will conceal the presence of a pest from an inspector by having the nurseryman's own employees inspect before the inspector's coming, pulling tell-tale leaves and twigs and spraying with a protective covering of Bordeaux with *plenty* of lime in it.

6th. The best inspection service in the world will only stop the most severely infested stock. No inspector can get it all, not if he has all the time and money in the world. The entire history of horticultural inspection proves this. It has probably retarded the spread of pests—but what pest has it actually stopped?

If taken in time, a pest can be eradicated completely for less than will be expended on it yearly in control measures alone, if not eradicated. One of the most important points in any eradication campaign is to have on hand a list of all points to which infected or suspected material has gone. This makes eradication possible at a reasonable figure.

In these days of world wide trade, and with the possibility of new pests being introduced on so many different products, it is a foregone conclusion that any quarantine service inaugurated by the Federal Horticultural Board, or state agencies will be merely a sieve which will barely keep out the most apparent, dangerous and easily intercepted pests. If only 80 percent. efficient, that quarantine service is thoroughly justified, but there are still one-fifth as many chances of our getting new pests, and they are going to keep coming in as long as we continue to trade with the outside world.

If these statements are true, no inspection service is adequate that stops with inspection only. If it is to give proper protection it must provide, for instant use, a complete record of all nursery stock moved with its sanction and permission.

The advantages of this arrangement are many and important:

First, it gives the Inspector a record as to where every plant that he certifies is planted. If he finds that a pest in Mr. A's nursery is very serious, he has only to go to his file, take out Mr. A's folder and he has instantly a complete record of the points to which Mr. A's stock has been shipped.

Second, these lists are valuable for other purposes. They show the State Horticulturist where the biggest plantings are being made: What the most popular varieties are: How the varieties differ in different sections of the State: How much and what kind of nursery stock is coming into the State: Whether a state exceeds in its imports or exports of nursery stock, etc. Much information of value to state officials is constantly to hand in these lists.

Third, they often enable the Inspector to nip in the bud a violation of the law. If an invoice passes through his hands that clearly indicates a violation, he can act promptly. If it raises his suspicions he can investigate. The invoices coming through the Florida office have given us the necessary clue on five or six occasions in the last four years.

Fourth, it stops the use of invalid and altered certificate tags so common in most states, for at the end of the year the nurseryman is required to return all unused tags to be canceled or destroyed by the Inspector. Then there are no invalid tags on hand to get mixed with the valid ones, or to tempt altering on the part of the frugal nurseryman.

Fifth, it stops the dangerous practice, so common in most states, of misusing certificate tags. Certificate tags are legal documents: They should not be used as address tags for shipping ordinary express and freight. To so use them is to lower their importance and significance in the eyes of transportation employees. But the most dangerous practice and one that is all too common in many states, is the intentional misuse of a certificate for deception. For example: Mr. Brown goes to the transportation office with a package of uninspected stock. The transportation agent refuses to accept the shipment because "there is no certificate tag attached." Mr. Brown goes home with his bundle, calls at Mr. Ray's nursery and "borrows" one of his certificate tags. This he attaches to his bundle and marches proudly and virtuously to the transportation office, often not realizing that he is violating the law, and not caring. He may strike a different agent at the transportation office, or if he strikes the same one the agent will not read the certificate and notice the discrepancy: Who ever heard of a transportation agent reading a certificate tag? Even if the agent should notice the discrepancy, what could he do? Nothing. The law says there must be a certificate tag attached to each package of nursery stock shipped. The law doesn't say that it must correspond in name to the shipper. If the tag is attached the agent's responsibility ends and off goes the shipment of uninspected stock under a certified tag—more dangerous than if it had no tag attached. Do you think this never happens in your state? It is happening in most states every day during the shipping season as the interceptions by the Florida Quarantine Department

prove. If Nurseryman Ray had to account to his State Inspector for each tag received, and the misuses of a certificate was prohibited under penalty of the law, he would refuse to give Mr. Brown a certificate tag.

Six years ago Florida had a disasterous experience which made the inherent weakness of the ordinary nursery inspection system very apparent. We have developed a system which overcomes this weakness. It has worked successfully for five years.

The time has come when nursery inspection requirements should be standardized to eliminate the many needless confusing and unimportant variations. We owe this to the nurserymen, the horticulturists and ourselves. The numbered certificate plan should be adopted as a standard requirement. The Nursery Inspector who ignores it is assuming a grave responsibility.

CHAIRMAN SANDERS: The next paper is by H. F. Dietz.

SOME PROBLEMS IN GREENHOUSE INSPECTION WORK IN INDIANA

By HARRY F. DIETZ, *Department of Conservation, Indianapolis*[1]

The total value of the greenhouses of the United States is between $75,000,000 and $100,000,000. In Indiana alone there are 4,500,000 square feet of ground covered by greenhouses conservatively valued at $5,000,000. Our State ranks seventh among the commercial flower-growing states of the Union, being surpassed only by New York, Pennsylvania, New Jersey, Illinois, Massachusetts, and Ohio. Little thorough work relating to the life history and control of the most common and destructive of these insect pests or plant diseases has been done. The florists have been left largely to shift for themselves and to devise control methods good, bad, and indifferent. Generally only in cases where the destruction of an entire crop has been threatened, through the spread of a serious pest such as the chrysanthemum midge, have entomologists as a whole aided the florists.

The problems arising in the inspection and certification of greenhouse plants for intra and inter state shipment have not been given the careful and thorough consideration they deserve. The writer does not presume to say how these problems should be dealt with, but will point out and illustrate by specific cases, the problems that have arisen in Indiana in order to awaken an interest in the matter.

[1]Published with the permission of the Director of the Department of Conservation and the Chief of the Division of Entomology.

It is necessary here to point out that there is a very important difference between greenhouse grown plants and nursery stock at the time each is distributed. Nursery stock is dormant when shipped. The leaves are off and practically all soil is removed from the roots. There are some exceptions as in the case of conifers and other evergreen plants. On the other hand plants grown under glass are generally shipped in a growing condition. Except in the case of cuttings and bud-wood, defoliation is out of the question and so is the removal of soil from the roots. Therefore, any insect or disease attacking the leaves, stems, or roots, are generally carried with the plants.

The first problem is, "What shall we regard as 'clean' plants?"—in other words, "What are plants free from dangerously injurious insects and plant diseases?" The following list of greenhouse insects (including mites) and plant diseases has been arranged in accordance with the prevalence of the pests in Indiana greenhouses (See p. 190).

It is evident that many of the tropical and sub-tropical insects, such as the mealy-bugs and scale insects listed, are serious pests in California and Florida and along the Gulf of Mexico; therefore, their very presence in a greenhouse ought to be sufficient grounds for refusing the grower a permit to ship plants to the regions mentioned. The terminal inspection systems in use in California and Florida will prevent infested stock from entering these states. Yet, should the presence of these pests warrant the refusal of a permit to ship when the plants are grown for northern distribution only, and where perhaps the only persons who will have trouble with them will be florists and their patrons? This distribution of, in most cases lightly infested, plants from florist to florist and from florist to patron has lead to some interesting results. Ten years ago the coleus was one of the most popular bedding plants in Indiana. But today that popularity has decreased so far that few florists grow this plant, and all this is due to mealy-bugs. The florists could not, or did not, keep these plants free from the pest with the result that when the plants were bedded out with others during the summer it was only a matter of time until the other plants, as well as the coleus, were infested and the bed ruined. The patrons of the florist have learned that the coleus is a plant not to buy because of the danger of their being infested with mealy-bugs.

Many Indiana florists have also discontinued the growing of palms and other subtropical plants used for decorative purposes because of the difficulty they have had in controlling the tropical and subtropical scale insects attacking them. Ten years ago a greenhouse was incomplete without a stock of palms and other tropical decorative plants. Such plants usually went from bad to worse year by year and as they died

INSECT PESTS INCLUDING MITES

Pest	Host on which it may be distributed
Red Spider (*Tetranychus telarius* Linn.)[1]	Roses, carnations, chrysanthemums, smilax, palms, aspidistra, etc.
Mealy Bugs (*Pseudococcus citri* Risso and *P. adonidum* Linn.)[2]	Coleus, geraniums, palms, rubber plants, Boston and related ferns, dracenas, etc.
Greenhouse White Fly (*Trialeurodes vaporariorum* Westw.)[2]	Pelargonium, fuchsia, primulas, celestial peppers and ornamental solanums.
Greenhouse Thrips (*Heliothrips haemorrhoidalis* Bouché)[2]	Rose, carnation, chrysanthemum, croton, aspidistra, *Ficus* spp. azalea, etc.
Plant Lice	*Aphis rufomaculata* Wilson and *Macrosiphum sanborni* Gill. on chrysanthemums[1]; *Macrosiphum rosae* Linnaeus on rose[1]; *Myzus persicae* Sulzer on carnations[1]; *Aphis gossypii* Glover on begonias, Easter lilies[2?]; *Cerataphis lataniae* Bdv. on Kentia palms.[2]
Boston Fern Scale (*Hemichionaspis aspidistrae* Sign.)[2]	On Boston and other ferns, aspidistra.
Chrysanthemum Midge (*Diarthronomyia hypogaea* F. Lw.)[2?]	Species and varieties of the genus *Chrysanthemum*
Greenhouse Leaf-tier (*Phlyctaenia ferrugalis* Hübn.)[1]	Chrysanthemum, cineraria, primulas, carnation. rose.
Rose Midge (*Dasyneura* [*Neocerata*] *rhodophaga* Coq.)[2?]	Roses.
Rose or Oblique-banded Leaf-roller (*Archips* [*Cacoecia*] *rosaceana* Harr.)[1]	Rose, carnation
Florida Fern Worm (*Eriopus* [*Callopistria*] *floridensis* Guen.)[2]	Various genera, species and varieties of greenhouse ferns.
Soft Scale (*Coccus hesperidum* Linn.)[2]	Ferns, palms, crotons, ornamental citrus plants, camellia, *Ficus* spp., bay trees, orchids, etc.
Hemispherical Scale (*Saissetia hemisphaerica* Targ.)[2]	Same as Soft Scale.
Oleander Scale (*Aspidiotus hederae* Vall.)[2]	Palms, cycads, ornamental citrus plants, orchids, bay trees, *Olea fragrans*. etc.
Florida Red Scale (*Chrysomphalus aonidum* Linn.)[2]	Palms, *Ficus* spp., ornamental citrus plants, *Pandanus veitchii*, *Dracena indivisa*, aspidistra, cypripediums.
Boisduval's scale (*Diaspis boisduvalii* Sign.)[2]	Palms, orchids (Cattleya spp.).
Strawberry Root-worm (*Paria canella* Fabricius vars. *alerrima* Oliv. and *quadriguttatus* Lec.)[1]	Roots? Soil (larvae).
Cyclamen Mite (*Tarsonemus pallidus* Banks)[2?]	Geranium, cyclamen, chrysanthemums, snapdragons.
Chaff Scale (*Parlatoria proteus* Curt.)[2]	Ornamental citrus plants, orchids (Vanda spp.).
The Crazy Ant (*Prenolepis longicornis* Latr.)[2]	In peat around orchids (*Cattleya* spp. and *Vanda* spp.) Only one record from Indiana.
The Greenhouse Orthezia (*Orthezia insignis* Dougl.)[2]	Coleus. Only one record from Indiana greenhouses, other hosts are lantana, verbena, chrysanthemum, gardenia.
The Argentine Ant (*Iridomyrmex humilis* Mayr)[2]	Pandanus, dracena, dieffenbachia, and aspidistra. See text p. 193 for a discussion of this insect. Has not been found in Indiana.

Disease	Host on which it may be distributed
Root and Stem Rot (*Rhizoctonia* sp.)	Carnation.
Wilt, Stem Rot or Die Back (*Fusarium* sp.)	Carnation.
Carnation Rust (*Uromyces caryophillinus* [Schrank] Winter)	Carnation.
Bud rot (*Sporotrichum poae* Peck)	Carnation.
Wilt (*Fusarium* sp.)	Chrysanthemum.
Anthracnose (*Gloeosporium rosae* Halsted)	Rose.
Cane Blight (*Coniothyrium fuckelii* Saccardo)	Rose.
Crown Gall (*Bacterium tumefaciens* Erw. Smith and Townsend)	Rose.
Rust (*Puccinia anthirrini* Dietel and Holway)	Snapdragon.

[1]Holartic insects

[2]Tropical or semitropical insects.

were replaced by others. Infested plants served as a harbor for scale insects and a source from which plants like ferns, which were often grown in the same house, became infested. When a florist sold a palm or similar plant he often got it back during the winter as a "boarder." Often he took it back in spite of his better judgment and set it among his own plants which he had fought hard to keep clean. In view of these facts should the grower who takes in "boarders," which are generally scale infested, be allowed to ship plants to another grower in another state who does the same thing? Or, if not, to what treatment should lightly infested plants be subjected to kill any infestation of scales or other insects occurring on them?

Ferns are delicate plants and when they become infested with insects it is practically impossible to "clean them up" without injuring the plants. Hence, what disposition should an inspector make in the case of ferns that show a very slight and scattered infestation of any of such scale insects as the soft scale, the hemispherical scale, or the Boston fern scale? It is needless to point out that a grower of ferns free from these insects is always afraid of introducing these pests on plants he buys. One florist in a small Indiana city bought several thousand fern plants infested with soft scale from a large grower and distributor in another state. These he unwittingly set among his clean stock with rather disastrous results. How can occurrences like this be best prevented?

The rapid spread of the chrysanthemum midge shows what may happen when a serious greenhouse pest becomes established in the greenhouses of one or more large growers. In 1914 it was known only from the houses of one large chrysanthemum grower, but by 1917 eight of the large distributors in widely separated parts of the United States had serious infestations. Fortunately we know now how to control the insect and most of the larger growers in Indiana have it under absolute control and several have practically exterminated the pest in their greenhouses. Nevertheless, its spread is continuing. In 1916 when widespread warnings were disseminated many of the smaller growers, such as local florists, became frightened and refused to buy mum plants for two or three years. But during the spring of 1919 and 1920, lead on by the high price of cut flowers, many florists "plunged" heavily on mums. Even those who bought only such plants as they needed of some new and popular variety often got the midge with them. One large distributor got an infestation in this manner. He fortunately did not buy any chrysanthemum plants from 1914 to 1919 and as a result had no midge. In 1919 he bought 200 plants of a new variety and luckily escaped the pest. But in 1920 he bought 250 plants of a

new variety from a jobber and with them came a light infestation so that this fall not only the plants he bought but two of his own varieties were infested slightly.

In many respects the rose midge is like the chrysanthemum midge. Though this insect has been known in the United States since 1887, its outbreaks have been more or less sporadic and probably dependent on the distribution of new varieties which have served as favorite food plants. The last distribution and resulting outbreaks of this pest took place with the dissemination of the popular rose, Ophelia. There is little doubt but that the plants, sent out by one of the several distributors of this variety, were infested with this midge. Ophelia is a fine seed parent and also shows a tendency to "sport" easily. Many of its "sports" and seedling offspring are held in high esteem by the florists and are constantly gaining in popularity with the flower-buying public. The reason I have mentioned this fact is that Indiana observations indicate that some of these sports and seedlings show the same susceptibility to the attacks of rose midge that their parent does and there are indications that another outbreak of this insect over wide areas is going to result.

The greenhouse white fly, because of the range of host plants it attacks, is very troublesome. It is difficult to control, especially when hydrocyanic acid gas is not used. Florists who have not had experience with this insect often scoff at the idea that it is a serious pest. But many Indiana florists have changed their minds regarding its importance. Those who have attempted to grow semi-hardy perennials like buddleia and bouvardia under glass or those who have lost a crop of indoor asters through its attack do not think it a pest of secondary importance. Those who grow fuschias, salvias, primulas and celestial peppers know that it is no easy task to control white fly. Yet one can find growers of some of its favorite food plants who have little or no difficulty in holding the insects in check, often without resorting to cyanide fumigation. In view of these facts what disposition should an inspector make of plants lightly infested with white fly?

Those insects and mites that occur out-of-doors in the northern two-thirds of the United States but have invaded greenhouses, like the red spider, the greenhouse leaf-tier, the rose leaf-roller, and the strawberry root-worm, present an interesting case. The first and the last named become serious pests out-of-doors but the other two do not seem to be nearly as serious pests in the open as under glass. If Indiana experiences are to be taken as a basis, it is safe to assume that both the leaf-tier and leaf-roller have been far more widely distributed through the medium of infested hosts than through the invasion of the greenhouses by moths.

or caterpillars, in widely separated localities. We have noticed that when any large grower and distributor has an outbreak of these two pests it is not long before a number of the smaller growers who have bought from the infested source have an outbreak. Hence, shall the presence in a greenhouse of any of these insects mentioned, even though they are being held in check successfully, warrant the withholding of a certificate of inspection?

The tropical ants are pests that seem to be gaining a foothold in our northern greenhouses. One of our florists bought a large collection of orchids from a jobber. With these he got the following insect pests,—a heavy infestation of *Parlatoria pergandii* Comst. on vandas, a heavy infestation of *Diaspis boisduvalii* Sign. on cattleyas and a scattering infestation of *Coccus pseudohesperidum* Ckll. and *Targionia biformis* Ckll. (both new coccid records for Indiana) on the same host. But what is probably more important than all these scale insects, he got a heavy infestation of the crazy ant—*Prenolepis longicornis* Latr. with nests in the peat in which the orchids were growing. Just what the outcome of its introduction into this Indiana greenhouse will be, remains to be seen. What action should the state in which this shipment originated have taken? And what action should the State of Indiana take to prevent the further distribution of this insect?

It is a common thing for Indiana florists to buy plants like aspidistra, ficus, *Dracena indivisa* and *Pandanus veitchii* that have been grown out-of-doors (or with slight protection in the winter) in the southern states. I was amazed to find that the greenhouses where a large southern distributor of aspidistras grew these plants were alive with the Argentine ant. What action should be taken to prevent the spread of this insect, northward?

Though comparatively little is known about greenhouse insects, far less is known about most of the diseases attacking plants grown under glass. There is carnation rust, the Fusarium root rot, and the Rhizoctonia branch and stem rot on this host. There is the snapdragon rust which has spread over the whole United States in the past twenty years. The widespread distribution of this disease might at one time have been checked. On roses we have such diseases as anthracnose and cane blight. There are doubtless many others which will attract attention following intensive study. Should the presence of any of the diseases mentioned in a greenhouse warrant the withholding of a certificate of inspection? Can infected plants be sent under a qualified certificate of inspection? Are these diseases dangerously injurious?

At present, three alternatives are open to state inspectors relative to plants grown under glass. The first is to let any and all persons who

desire to ship greenhouse plants do so on the grounds that such plants do not come under the regular nursery inspection requirements. Technically this view is correct. The second alternative is to inspect the plants and issue a certificate if the plants are free from insect pests and plant diseases at the time of inspection and if measures are being taken by the grower to keep them so. The third alternative is to issue qualified certificates of inspection provided there are no dangerously injurious insects or diseases present or new and uncommon ones which are very restricted in their distribution. Certain combinations of these three alternatives are in use in some states. In these cases if a grower is refused a certificate of inspection he can ship his plants by merely attaching a statement to them that they are greenhouse grown and are thus exempt from inspection. Thus the man who grows clean stock for distribution is at a disadvantage in that he must compete with the one who does not. Also in such cases anyone who wants to sell greenhouse plants, no matter how badly they are infested with insects or infected with diseases, can sell them and there is nothing in most states that will protect the buyer of these plants except the contract he has with the man from whom he is buying.

Now if the certification of greenhouse plants is undertaken what shall the basis of such certification be? How often and when shall the plants be inspected? Thirty days will often change the entire aspect of the insect and disease conditions in greenhouses. If there is but a single inspection when shall that be? The presence of the rose midge may not even be suspected if an inspection is made from December to March. Chrysanthemum midge, especially where a light infestation occurs, might be overlooked if the inspection were made during the summer, from the last of June to the first of October. During the months from December to April only the most careful inspection would reveal the occurrence of the strawberry root-worm.

In general, it might be said that two inspections, one in the summer and one in the winter, ought to give the inspector a good idea not only of the insect and disease conditions in a given greenhouse but also an idea of the grower's ability to "clean up" his plants and keep them so.

CHAIRMAN SANDERS: We are glad to have these observations on a rather new line of inspection which is coming more and more to the front in this country, particularly in some of the larger states where florists' establishments occupy an important place in horticulture.

If there is no discussion of this paper, we will proceed to the next number by J. E. Graf of Maccleny, Florida.

SWEET POTATO WEEVIL ERADICATION TESTS IN FLORIDA

By J. E. GRAF and B. L. BOYDEN, *Bureau Entomology*

(Withdrawn for publication elsewhere)

CHAIRMAN SANDERS: The next paper is by J. H. Montgomery.

PLANT QUARANTINE WORK AT FLORIDA POINTS

By J. H. MONTGOMERY, *Gainesville, Fla.*

Plant quarantine inspection at ports of entry is a development of comparatively recent date. The State of California was the pioneer in this kind of work and 30 years ago recognized the necessity of not only preventing the spread within the State of pests which were already present but also of preventing the entry of pests from outside her borders. In this work she has been preeminently successful and the methods made use of by California have formed the basis for similar work by other states and countries which have since seen the wisdom of applying the principle expressed in the old proverb about the ounce of prevention being better than the pound of cure. The Japanese Imperial Plant Quarantine Service is modeled after that of California. The Federal Horticultural Board has recognized the efficiency of California's system and the State Plant Board of Florida, when it contemplated inaugurating a similar service, made use of California's long and successful experience. So far as I am informed, California and Florida are the only states which maintain a protective first line of defense in the form of a maritime port inspection service. Arizona has a very effective service at her border ports and other states have good interior inspection systems but it is not our purpose in this paper to discuss any phase of plant quarantine work other than that done at maritime ports of entry and with particular reference to Florida.

Florida for many years, notwithstanding her tremendous horticultural interests labored under the handicap of an inadequate horticultural law. In fact, there was little or no law—and about the same amount of money with which to apply the provisions of the law. It required what was little less than a calamity, that is the introduction and spread of citrus canker, to arouse the fruit growers of Florida to the dangers to which they had been and were exposed. In 1915 the Legislature passed what is known as the Florida Plant Act of 1915. This law has since proven adequate in every respect and has been used as a model for similar laws enacted by several other State Legislatures. I may have

appeared to have digressed somewhat from the topic of my paper. As a matter of fact, however, I have just told you of the very foundation of a successful and efficient port quarantine service, a good law. Secondary to the good law is ample financial support. Realizing this, the Florida Legislature has made liberal appropriations for administering the provisions of the Plant Act.

With the bitter experience with citrus canker, an introduced disease, as an example, the State Plant Board determined that this disease should not again be introduced nor should other pests be brought in if possible to keep them out. Florida, owing to her peculiar geographical location, is exposed to attack by enemies from Central and South America and from the West Indies. Then too, owing to the subtropical nature of her climate, unwelcome visitors find a congenial home. Our task, therefore, was no light one. The State Plant Board, shortly after its organization created, under the direction of the Plant Commissioner, a port inspection service which beginning in a modest way has developed with age and experience. We now have inspection stations at all of the principal ports of entry in Florida, namely, Pensacola, Jacksonville, Miami, Key West and Tampa. Depending upon the volume of imports and passenger traffic, our force ranges from one to three men at each of these ports. I am frank in stating that this force is just about half the number really needed. These men are all trained and experienced inspectors who have seen service in other branches of Plant Board field service. Many of them have been educated as entomologists and plant pathologists, not all. In this connection, I would point out that in work of this nature, which after all is police or regulatory work, a high degree of technical training in entomology and pathology, while very desirable, is not essential. A knowledge of these subjects, such as may be gained by elementary courses or practical field experience is sufficient. In fact, some of our very best men have had no collegiate training whatever in entomology or plant pathology but these men as well as those who are technically trained *must* and *do* possess other qualifications which are of primary importance.

From the very nature of the work in which they are engaged our men encounter many difficult and trying situations. I am glad to say that invariably they have been able to overcome the difficulties and to handle unpleasant situations without an undue amount of friction. They have been courteous but firm, decisive but never offensively so, accommodating but not lax. The successful performance of the many duties devolving upon them calls for the employment of men of the very highest type. They must be men who can impress the public with the fact that they know their business and intend to attend to it. Being men of this

type they have been able to secure and hold the cooperation of Customs and transportation officials and that of commercial shippers. Without this cooperation their work would be seriously hampered if not made worthless.

As to the nature of the duties our men perform, it would be difficult to pen a picture graphic enough to give you a complete idea. The duties are multitudinous and comprehensive. All men holding appointments in the port quarantine service of the State Plant Board of Florida also hold appointments as collaborators of the Federal Horticultural Board, thus having to administer plant quarantine rules and regulations of both the federal and state governments. This arrangement is very advantageous, for as federal officials they possess certain authority and prestige not conferred through state appointment. The State Plant Board of Florida has, however, paid the salaries and borne all other expenses incident to the conduct of the work. There are some situations presented which are fully covered by federal rules, others by state rules and many by both state and federal measures. In the application of federal, as well as state regulations, it is necessary that the closest and most cordial relations shall exist between our men and the customs officials, for the reason that under the Federal Plant Quarantine Act of 1912, the application of the rules and regulations made by the Federal Horticultural Board is placed in the hands of the customs service. I mean, particularly, the matter of search of vessels, cargoes, baggage and passengers for materials coming under the provisions of the Act. Theoretically, therefore, plant quarantine inspectors are to act largely in an advisory capacity to the customs. In actual practice though, not only at Florida ports but in California and at such ports as have been opened as inspection stations by the Federal Horticultural Board, the plant inspectors really do make the search for contraband or regulated plant material and quite frequently assist customs officials in other ways. Sometimes it would be difficult for the casual observer to tell from the nature of the duties performed whether a man were a plant inspector or a customs inspector, so close is the cooperation and the interest of each in the work of the other. To a lesser degree, the same applies to our relations with officials of the immigration and public health services.

In their dual capacity our men, during the year ending April 30, 1920, boarded 4,500 vessels arriving at Florida ports. These have been inspected from stem to stern. Passengers' cabins and crews' quarters have been carefully searched. Every place where contraband plant material might be secreted has been investigated. Three hundred and fifty thousand parcels—baggage and commercial shipments—have been handled as being potential disease or insect pest carriers. Of this

number more than 4,000 have been refused entry as being dangerous. It is a common occurrence for our men to intercept material infected or infested with some disease or insect which is not now known to be present in this country and which if introduced would occasion great losses.

The question naturally arises as to the object and the net results of all this organization and the work done by it. It is hardly necessary for me to point out the object we seek to obtain. Horticultural history is replete with "horrible examples" of plant pest introductions in combating which the producer has paid a heavy toll for our neglect. We need not go far back for such examples, the gipsy and brown tail moths, San Jose scale, Japanese beetles, citrus canker, European corn borer, European potato wart, chestnut blight, white pine blister rust, Mexican boll weevil, Colorado potato beetle, pink bollworm; these are just a few. Florida and California have many insect pests and plant diseases which could have been kept out. The South Atlantic and Gulf States, as well as California, are particularly exposed to invasion by the Mediterranean fruit fly and other fruit flies. Europe, Africa and South and Central American and Oriental countries harbor plant enemies which must not be introduced into this country if our horticultural and agricultural industries are to continue to prosper. It is to keep these enemies out that California, Florida and the Federal Horticultural Board maintain their plant quarantine services and it is for the same reason that other coastal and border states should inaugurate similar services and that all states, coastal and interior, should see to it that the Federal Horticultural Board, through Congress, is supplied with ample funds for carrying on its work. It is to be regretted that the Board, through no fault of its own, has never since its creation been able to expand and develop its activities along the line of maritime port inspection to the extent which it undoubtedly desired and which it knew was necessary to afford the protection needed. I may be an enthusiast on this subject but I am of the opinion that the Congress should place at the disposal of the Federal Horticultural Board a quarter million dollars or more annually in order that all ports of importance can be properly safeguarded, this, too, irrespective of such efforts in the same direction as border and coastal states may make. I am of the further opinion that the very best results can only be secured by a continuation of the liberal policy of close cooperation between federal and state forces, such as is now in existence in California and Florida, with this difference, however, that the federal government should bear a greater portion of the financial burden than heretofore. After all, this matter of plant quarantine service is one of national concern rather than state or sectional.

As to the net results of our efforts in Florida, the following brief summary will perhaps serve:

During the period from May 1, 1919 to April 30, 1920, over 4,500 vessels arriving at Florida ports were boarded and inspected—2500 of these from foreign ports. In round figures 350,000 packages were handled during the year by our quarantine inspectors. Two thousand of these were returned to shippers—2,400 destroyed as dangerous.

Pests from 19 foreign countries or possessions were prevented entry during the year, the countries of origin as follows:

Argentine	Dominican Rep.	Japan
Bermuda	Ecuador	Jamaica
Bahamas	France	Nicaragua
Canary Islands	Grand Cayman	Mexico
Cuba	Haiti	Porto Rico
China	Isle of Pines	Panama
		Spain

One hundred and forty (140) different plant pests were discovered on importations, some of these pests not now known in this country. A number of these pests have occasioned great losses in the countries where they are established and would no doubt occasion as great or greater loss if introduced into the United States. Perhaps the most notable interceptions from the standpoint of potential danger were black fly, which has been intercepted on five occasions on material from Cuba and the Bahamas. Jamaica yam weevil, which occasions great damage to yams in Jamaica and other West Indian Islands, was found on a shipment of yams from Jamaica via Cuba. This weevil is not known to be present on the mainland and doubtless if introduced would occasion tremendous loss to the sweet potato crop. No less than eight serious insect pests not now known to be present in the United States were intercepted by our inspectors.

The Florida plant Board does not confine its protective efforts solely to inspection. Complete equipment for the fumigation of fruit and vegetable offerings from foreign countries are located at Key West and Port Tampa. Each of these chambers will accommodate 700 standard crates. During the active shipping season of the past summer and fall over 56,000 crates or barrels of fruits and vegetables from Cuba were treated. The treatment consists of hydrocyanic acid gas—1½ ounces of sodium cyanide per 100 cubic feet of space. No damage to fruit has been noted and no injury to consumers. The construction of these fumigating plants well illustrates the relations between ourselves and the transportation companies. When the necessity for treating shipments of fruits and vegetables, particularly from Cuba was pointed out to the carrying companies, together with cut inability to provide suitable plants, the companies promptly undertook the construction and equipment of same.

The conclusion must not be drawn from the foregoing that the activities of the quarantine department of the State Plant Board are restricted to port inspection. Such is not the case. Our men are constantly on guard to prevent illegal movements of nursery stock, sweet potatoes, sugar cane and other products, both inter- and intra-state. Watch is kept over the various transportation agencies—express cars and sheds are inspected and freight yards and warehouses kept under observation. Various other important duties devolve upon our quarantine inspectors but the most important of all is the port inspection work.

No paper of this nature and presented at this time would be complete without some reference and tribute to the work of the Federal Horticultural Board and particularly of the Chairman, to whose efforts largely is due the fact that we now have on the statute books of the nation a plant quarantine law. For many years the Chairman contended for legislation unsuccessfully, but with indomitable will and bulldog tenacity refused to give up the fight; finally overcoming opposition and succeeding in having passed the Federal Plant Act of 1912. Since that time he and his associates on the Board have been untiring in their activities with corresponding accomplishments.

To sum up, I should say that the main factors contributing to successful quarantine work are:

1. A good law and reasonable rules.
2. Sufficient financial resources.
3. Competent men.
4. Co-operation and good will of commercial and transportation interests and of officials of the customs, immigration and other public services.
5. Application of the provisions of quarantine regulations in such a way as to afford the maximum amount of protection with the minimum amount of inconvenience to parties concerned and occasion the least interruption to commerce and traffic

These are the cardinal principles.

CHAIRMAN SANDERS: It might have been better had we had Mr. Beattie's paper following Mr. Marlatt's address, but I think he has some important things to tell us at this time on "Operation of Quarantine 37."

THE OPERATION OF QUARANTINE No. 37

By R. KENT BEATTIE, *Pathologist in Charge Foreign Plant Quarantines, Federal Horticultural Board, Washington, D. C.*

Quarantine 37 is the general nursery stock quarantine which, as supplemented by various special quarantines, now regulates the movement of plants and plant products into the United States. It became effective June 1, 1919.

Soon after this quarantine became effective the Federal Horticultural Board organized the Office of Foreign Plant Quarantines to handle the work connected with the operation of this and other foreign quarantines.

Plants and plant products enter the United States under the provisions either of Regulations 2, 3, or 14 of Quarantine 37. Regulation 2 permits the entry without restriction of field, vegetable and flower seeds and certain plant material imported for medicinal, food or manufacturing purposes.

Regulation 3 authorizes the entry under permit of certain bulbs, fruit and rose stocks, nuts, and seeds. The procedure under this regulation is in the main the same as that which previously obtained under the old nursery stock regulations. A permit, foreign inspection and certification, proper marking, and notices of shipment and arrival are required. With the exception of the bulbs the inspection is conducted as formerly by State inspectors acting as collaborators of the Federal Horticultural Board. The bringing under regulation of the great quantity of lily, lily of the valley, narcissus, hyacinth, tulip and crocus bulbs which annually enter the United States, presented a problem in inspection which the State inspectors were frequently not prepared to meet. Their funds had been secured and their forces organized on the basis of the inspection of fruit trees, ornamentals and their stocks. Fortunately bulbs are easily inspected at port of arrival. They require no machinery to repack. They are less likely to convey pests and pests are more easily detected upon them. In the case of those bulbs which enter the United States at the nine ports of arrival where the Federal Horticultural Board now maintains an inspection force, provision has, therefore, been made for the completion of their inspection and their release at the port of arrival.

Regulation 14

Regulation 14 provides for the importation in limited quantities and under special safeguards of nursery stock and other plants and seeds not covered in Regulations 2 and 3 for the purpose of keeping the country supplied with new varieties and necessary propagating stock. Although the plants imported under Regulation 14 amount to about one per cent. only of those imported under Regulation 3, they represent a far greater

amount of care, study and interpretation of the regulations. Under Regulation 14 every case is a special case and requires special consideration. The first step in the procedure followed in the issuance of a special permit consists in the making of an application by the proposed importer. For this he uses form 207. He lists the varieties of plants which he wishes to import and furnishes the importation data. He furnishes information as to the plants he desires and their propagation. He certifies to the accuracy of the facts submitted and agrees to the conditions of entry. Essentially the application consists of (1) a list of varieties, (2) a statement of facts, and (3) an agreement.

The consideration of this application is undertaken by the Office of Foreign Plant Quarantines. The varieties requested are submitted to the Bureau of Plant Industry for consideration. The application is submitted to the chief of the Bureau who appoints a committee of experts to consider it. This committee makes recommendations to the Federal Horticultural Board as to the commercial availability of the varieties in the United States and the reasonableness of the quantity requested. This committee is furnished with any data on availability in the possession of the Office of Foreign Plant Quarantines in additon to the data possessed by the experts themselves. The findings of the Bureau of Plant Industry Committee are submitted to and approved by the Chief of the Bureau of Plant Industry, himself a noted horticulturist, before they are returned to the Board. The records as to the recommendations of the Bureau of Plant Industry experts are kept in the office of Foreign Plant Quarantines. Since many varieties are requested again and again by different importers, in many cases no new decisions are involved and no consultation is necessary. For instance, 89 different special permits, issued between June 1, 1919, and December 10, 1920, included the new Dutch variety of gladiolus called Le Marschal Foch.

In determining what varieties are or are not available in the United States in quantities sufficient for propagating purposes the policy of the Federal Horticultural Board has been to be liberal. A liberal policy has also been followed in regard to the quantities permitted import. It has been felt that if a variety is not available here and it is to be established here the sooner the introduction is accomplished and we can rely upon American production the less dangerous is the importation. The introduction of small quantities from various localities over a series of years multiplies the danger.

In the consideration of an application it is necessary also to consider the purpose of the importation. Importations under Regulation 14 are

permitted for the purpose only of keeping the country supplied with new varieties and necessary propagating stock. They are not permitted for immediate commercial distribution or for the mere ornamentation of private estates. Special permits are issued to commercial propagators, to amateur propagators and to botanical gardens. The value of the amateur fancier and student of plants and the grower of a special collection to the development of American Horticulture is recognized by the regulations. Every effort is made to discriminate fairly between such cases and those where plants are desired merely as ornaments. Among the most difficult cases to handle are those where plants are desired merely for sentimental reasons: roses from the old home in England, plants from the battlefields of France, dwarf Japanese trees in the baggage of tourists, and so on ad infinitum. It is manifest that such applications usually fall without the limitations of the quarantine and cannot be authorized.

During all this consideration the bearing on the case of some 40 odd special quarantines and restrictive orders such as the citrus quarantine must be kept in mind.

When the application is granted a bond is prepared and sent to the permittee with his copy of the permit. This bond he executes and returns to the Board. He is bonded in the sum of twice the estimated value of the shipment to live up to his agreement with the Board. In a great many cases such a bond is unnecessary, but a few plant growers must be forced to comply with their agreements, and it is impossible to discriminate between individuals in the enforcement of the quarantine. Public institutions such as botanical gardens are, however, not required to furnish the bond.

When the plants come from abroad and reach the port of first arrival—which is usually New York—they follow the usual nursery stock course. The importer or his representative files with the customs authorities the usual customs papers accompanied by a notice of arrival and a notice of shipment and asks for customs authority for immediate transportation of the plants to the port of entry (Washington or San Francisco, as may have been specified). The notice of arrival and shipment are turned over to the Federal Horticultural Board inspectors by the Customs authorities. On that same day, or if the papers come in late in the day, on the next day, the material is located on the piers and examined to see:

(1) If it complies with the Regulations as to certification and markings, and

(2) If it is free from sand, soil, and earth, and is not obviously infected or infested.

A few boxes at random are opened, but only a very small portion of the material is examined. If passed, the immediate transportation customs papers are signed by our inspector and the movement of the material to Washington or, if on the Pacific coast, San Francisco is authorized.

Delay at the port of arrival or in transit is never due to our inspection. Thus far, all of the special permit material has arrived at New York, San Francisco, or Seattle. At each of these three ports we have an adequate inspection force of competent men. Delay is usually due to:

(1) A lack of knowledge of customs procedure on the part of the importer and a consequent failure to provide for the services of a broker to get track of the goods when they arrive and to make proper customs entry.

(2) Dilatoriness on the part of brokers and transportation companies.

If Washington is the designated port of entry, the material arrives at that port in a customs bonded car and is hauled immediately to our Inspection House by a customs bonded transfer company. Our Inspection House has the status of a customs bonded warehouse. The material is inspected at once. If it is free from pests and the requirements have been complied with, the Collector of Customs is notified and the material is released. Small packages are shipped out at once by our own men in accordance with the instructions of the importer. If the shipment is a large one, it is turned over to the importer's customs broker for handling.

Shipments arriving at San Francisco intended for Pacific Coast points are inspected and released there. In spite of the wild statements frequently issued, no shipment has ever crossed the continent to be inspected at Washington and returned to the Pacific Coast.

After arrival at destination the plants are grown and propagated by the importer at the designated place for a period of one to five years, as specified in the bond. The length of time specified depends upon the nature of the plants. Gladiolus bulbs, for example, are bonded for two years; bulblets for three; orchids for five.

As far as is possible, each lot of material is visited annually during the growing season by an inspector of the Federal Horticultural Board and reinspected under field conditions.

In the 18⅓ months in which the quarantine has been in operation up to December 10, 1920, 554 special permits have been issued to 273 different permittees. The material imported under these permits is being grown or will be grown in or near 214 different towns in 32 different states.

CHAIRMAN SANDERS: Mr. Stockwell is not here to present his paper on "The Japanese Beetle Quarantine," but we have his paper. Mr. Sasscer asks that his paper on "Important Foreign Insect Pests Collected on Imported Nursery Stock in 1920," be eliminated.

The next thing is the transaction of business, the first item being the report of the Nominating Committee.

MR. DIETZ: Your Committee on Nominations wishes to propose the following names for officers of this Section during the ensuing year:

Chairman of the Horticultural Section and Third Vice-President of the American Association of Economic Entomologists: Prof. A. G. Ruggles, St. Paul, Minnesota.

For Secretary, Mr. E. R. Sasscer of the Federal Horticultural Board of Washington, D. C., who has shown his ability to give us one of the most interesting programs the Section has had for several years.

MR. COTTON: I move that the report be adopted, that we approve the selection, and the names be referred to the Association for election.

The motion was duly seconded and carried.

Adjournment.

Joint Meeting

American Association of Economic Entomologists and American Phytopathological Society

Friday Morning, December 31, 1920

The joint meeting of the American Association of Economic Entomologists and the American Phytopathological Society was held Friday morning, December 31, 1920, at the University of Chicago.

It was called to order at 10.30 a. m. by President Wilmon Newell of the former association.

PRESIDENT WILMON NEWELL: This meeting is the result of an invitation extended to the American Phytopathological Society by the American Association of Economic Entomologists which was most graciously accepted by the former society.

As entomologists we are very glad that the Phytopathologists accepted our invitation, as this means a great deal to us and it is an indication of progress. It is also a confirmation of our belief that the two societies entertain for each other that friendship and spirit of cooperation which is invariably shown between Phytopathologists and Entomologists as individuals. It is appropriate that the president of the visiting society should preside over our deliberations this morning. He needs no intro-

duction to the plant pathologists, who are familiar with his many scientific achievements. Some of the members of the American Association of Economic Entomologists, however, may not be so fortunate as to know Dr. Orton personally, and to them I take pleasure in introducing Dr. W. A. Orton, President of the American Phytopathological Society who will preside this morning.

PRESIDENT W. A. ORTON: As retiring president of the Phytopathological Society, I wish to express our appreciation of the invitation from the Entomologists which has brought us together today and to express our convictions that such meetings ought to come more frequently. Perhaps they should have come earlier. It has even been suggested that we in this country have made a mistake in developing two branches of plant pest study and control separately and independently of each other. At any rate, each passing year reveals new points of contact.

We shall discuss today only one phase of the problem of control wherein similar methods are used to combat both insects and diseases. "A Symposium on Dusting as a Means of Controlling Injurious Insects and Plant Diseases" is to be presented.

The first paper will be given by Mr. P. J. Parrott, Geneva, N. Y.

CONTROL OF SUCKING INSECTS WITH DUST MIXTURES[1]

By P. J. PARROTT, *Geneva, N. Y.*

The efficient protection of bush and tree fruits involves several factors —the prevention and control of plant diseases, the repression of leaf- and fruit-eating insects, and the destruction of certain haustellate species which are commonly classified as scales, aphids, capsids, etc. It is self-evident that no system aiming to afford protection to fruit plantings satisfactorily meets practical necessities which does not secure adequate control of all three categories of parasites. In considering the merits of dusting as related to orchard management in New York, there has been a great lack of experimental data regarding the value of dusting in combating such insects as San Jose scale, blister mite, green apple aphis, rosy aphis, leafhoppers and redbugs. Although apple scab and codling moth usually levy the largest tribute, the shrinkage in yields due to attacks of sucking insects is by no means insignificant and during some seasons the accumulative losses reach impressive proportions. Certainly, no grower in this state is properly conducting

[1]Condensed from a paper presented to the joint meeting of the Association and the American Phytopathological Society at Chicago, Dec. 31, 1920. Typical tests have been selected to illustrate the nature of the investigation and the average results secured.

his orchard operations who fails to make provisions for the control of these pests. Likewise, the neglect of pear psylla, thrips, or the green bug is likely to be attended with serious consequences as is usually manifested by the reduced yields and impaired vitality of the trees. Similar considerations hold true for the grape leafhopper, the currant aphis and four-lined plant-bug, the potato aphis and leafhopper, and the onion thrips. In view of the importance of this class of insects and of the need for information as to their susceptibility to dusting preparations, the Geneva Station began a serious investigation of the problems during the past season. My contribution to this symposium, therefore, deals largely with the more important results of this inquiry.

Tests with Various Fruit Insects

A series of experiments are here described which were designed to ascertain the effectiveness of dusting mixtures on a number of common sucking insects. The objects which we hope to attain, and which we succeeded in attaining in part, were: (1), Data on the susceptibility of various insects to dusting preparations with definite ratios of nicotine; (2), some knowledge of the efficiency of dusting for the control of certain species under field conditions; and (3), information as to the importance of accessory factors in the effectiveness of dusting operations.

Conditions of the Tests

The following species of insects were used in the experiments: The green apple aphis (*A. pomi* De Geer), the rosy aphis (*A. sorbi* Kalt.), the grain aphis (*A. avenæ* Fab.), the apple leafhoppers (*E. rosæ* L. and *E. unicolor* Gillette), the apple redbug (*Lygidea mendax* Reuter), the pear psylla (*Psylla pyricola* Forster), the currant aphis (*Myzus ribis* L.), the four-lined leaf-bug (*Poecilocapsus lineatus* Fab.), and the potato aphis (*M. solanifolii* Ash.) The dusting preparations were applied with "hand dusters," "hand blowers," or orchard power outfits. A mixture of superfine sulfur, 90 percent. and powdered lead arsenate, 10 percent. was the carrier of the nicotine. In many of the experiments provision was also made for application of liquid insecticides at standard strengths.

Susceptibility of Insects to Dusting Preparations

The Apple Redbug

Experiments with apple redbugs were conducted on June 1 and 2 in an 18-year-old orchard composed chiefly of such varieties as Greening, Hubbardston and Baldwin. This planting had suffered serious injuries for successive years, and at the time of the test over 90 percent. of the

terminal growth of many of the trees was damaged. In Plat I ten Greening trees were dusted with a preparation containing 0.5 percent. nicotine. A little more than fifty pounds of dust were applied and one tree (Tree 1) was very thoroughly dusted. In Plat II seventeen Greening trees were dusted, using from eighty-five to ninety pounds of material. One Greening tree (Tree 2) was given an application of two and one-half gallons of lime-sulfur diluted with one hundred gallons of water to which was added one pint of nicotine sulfate. To insure thorough treatment, twenty-three gallons of the mixture were applied. In the treatment of the individual trees much care was exercised to make thorough applications without any attempt to economize on materials. Fumigation sheets were spread on the ground beneath each tree in order that the redbugs could be collected as they fell. After the first count the trees were shaken quite violently at repeated intervals and after each operation the condition of the insects, whether dead or alive, recorded. The effectiveness of the different treatments is indicated in Tables I and II.

TABLE I—EFFECTS OF DUSTING ON REDBUGS

Condition of Insects	Tree 1 Dusted	Tree 2 L. S. and Nicotine Sulfate	Tree 4 Check
Dead	437	594	14
Living	132	36	317
Total	569	630	331
Percent. living	23.2	5.7	96.7

TABLE II—INFLUENCE OF DUSTING FOR REDBUGS IN PREVENTING INJURIES TO FRUITS

Treatment	No. of Apples	No. Apples Injured	Percent. Injured	
Dust, 0.5 percent. nicotine	717	41	5.7	Average 5.3
	1682	84	4.9	
Dust, 1.0 percent. nicotine	1349	201	14.9	
	2280	198	8.6	
	595	26	4.4	
	2857	149	5.2	
	1266	72	5.7	7.4
Lime-sulfur and nicotine	1228	15	1.2	
Check	1120	997	89.0	

Redbugs proved very sensitive to nicotine, dusting preparations carrying this ingredient producing almost instant paralysis upon coming in contact with the insects. No difference in rapidity of action or in effectiveness was discerned between the dusting preparations which contained respectively 0.5 and 1.0 percent. nicotine.

The Apple Aphids

The conditions under which the experiments with aphids were carried out may be briefly described as follows: Apple buds infested with newly hatched nymphs of *avenæ*, *pomi* and *sorbi*, principally the former species,

were thoroughly dusted with preparations containing 0.5, 1.0 and 2.0 percent. nicotine. As previous experiments had indicated that there was very little difference between the three species with regard to their susceptibility to the dust, and since the majority of the nymphs belonged to *avenæ*, the counts were made without any attempt to distinguish the different species. The effects of the dusting on the aphids are given in Table III.

TABLE III—RESULTS OF DUSTING AGAINST APPLE APHIDS

Treatment	No. of Buds	Original No. of Aphids	Average No. Aphids per Bud	Percent. dead after 4 Days
Dust 0.5 percent. nicotine	40	121	3.02	91.7
Dust 0.5 percent. nicotine	32	80	2.5	98.7
Check	32	81	2.56	27.1
Check	17	38	2.2	65.5
Dust, 1 percent. nicotine	37	89	2.4	87.6
Dust, 2 percent. nicotine	50	107	2.14	97.2
Check	18	42	2.3	47.8
Dust, air-slacked lime	53	127	2.4	78.6
Lime-sulfur and nicotine	58	120	2.03	97.5
Check	14	25	1.78	60.0

At the time of the opening of the apple buds the extent of infestation by aphids may be greatly influenced by such factors as driving rains, sleet storms, high winds and low temperatures. The reduction in the number of insects on the checks by natural means was considerable in some instances, and it is reasonable to suppose that similar influences operated on the sprayed and dusted series. A study of the data shows that, on the whole, dusting compared quite favorably with spraying in insecticidal efficiency. It should also be noted that a heavy application of air-slaked lime resulted in a loss of 78.6 percent. of the aphids.

One of the interesting results of the season's activities with aphids is that different species are apparently not equally susceptible to dust mixtures with the same nicotine content. The fact that some aphids are more resistant than others was most clearly demonstrated in some tests with *M. solanifolii* and *S. lanigera*, which proved very much less susceptible to treatment than the common apple species, such as *pomi*, *avenæ* or *sorbi*.

The Apple and Grape Leafhoppers

In the experiments against the apple redbugs, to which attention has previously been called, the nymphs of *Empoasca unicolor* and *Empoa rosæ* proved very susceptible to dust mixtures containing 0.5 and 1.0 percent. nicotine and fell completely paralyzed in large numbers on the collecting sheets. As the control of these species was not contemplated when the work was undertaken, no attempt was made to determine the effectiveness of the treatment in protecting apple trees.

In an experiment with grapes, an application of dehydrated copper sulfate and lime containing 2.0 percent. nicotine destroyed eighty percent. of the nymphs of the leafhopper.

Since the foregoing species are apparently quite vulnerable, a problem deserving serious attention is the value of this system of treatment in combating such insects in commercial plantings of apple and grape.

The Pear Psylla

During the past summer a special effort was made to ascertain the comparative effectiveness of various spraying mixtures and dusting preparations in controlling psylla nymphs. As the results, in general, were quite similar one experiment is selected as typical. On June 3, 1920, a plat of thirty Bartlett trees, about fifteen years old, was sprayed with bordeaux mixture (4–4–100) to which was added 6 pounds of paste lead arsenate and 1 pint nicotine sulfate. Four gallons were applied on the average to each tree. An adjoining plat of sixty trees of the same variety was dusted on the following day with a mixture composed of 50 pounds sulfur, 10 pounds lead arsenate, 5 pounds nicotine sulfate, and 30 pounds powdered tobacco. About 2⅔ pounds were applied on the average to each tree. Before treatment the nymphs on fifty tagged spurs on each plat were counted, and on the day following the operation each of these spurs was re-examined and the nymphs present recorded. The data are given in Table V.

TABLE V—COMPARATIVE EFFECTIVENESS OF SPRAYING AND DUSTING AGAINST PSYLLA NYMPHS

Material	Nymphs per Spur before Treatment	Nymphs per Spur After Treatment	Nymphs Killed
	No.	No.	Percent.
Bordeaux mixture and nicotine sulfate	42.57	0.30	99.4
Sulfur and nicotine sulfate	41.58	15.92	61.7

In this experiment, as with other similar efforts, the dust mixture killed a goodly percentage of nymphs; but, as compared with spraying, the treatment proved considerably less effective. The nymphs secreted in the axils of the leaves and fruits and, heavily coated with honey dew, displayed the greatest resistance. It was under such conditions that the inferiority of dusting to spraying was most marked.

In experiments with hibernating adults, spraying proved very much superior to dust mixtures as measured by the number of adults dislodged from the trees and the percentage killed by the treatment.

The Currant Aphis and Four-Lined Bug

Mixtures containing 0.5 and 2.0 percent. nicotine produced complete paralysis of currant aphids. With the opening of currant buds it became increasingly difficult to do effective dusting because of the interference of the dense foliage.

Nymphs of the four-lined bug proved very much more resistant to nicotine than the apple redbug or certain species of aphids. Preparations containing 2.0 percent. nicotine caused paralysis, from which none recovered. As with the aphids, dense foliage produced by the new growth made it very difficult to secure effective control by dusting.

Principal Findings and Discussion of Results

Dusting mixtures containing nicotine were toxic to aphids, redbug, leafhoppers of the apple, the currant aphis and four-lined plant-bug.

The degree of susceptibility to dusting preparations varied with different species. Mixtures with 0.5 percent. nicotine were fatal to the apple aphis and redbug and to the currant aphis. Preparations at this strength also reduced nymphs of the four-lined plant-bug to a state of inactivity, although the insects ultimately recovered with few fatalities. Dusting with mixtures containing 2.0 percent. nicotine was fatal to the nymphs. Mixtures containing less than 2.0 percent. nicotine gave very poor control of the potato aphis. The nymphs of the pear psylla displayed considerable resistance to preparations containing from 0.5 to 2.0 percent. nicotine. Mixtures with 0.5 percent. nicotine destroyed only a small percentage of hibernating adults, and preparations with 1.0 percent. nicotine were less effective than spraying mixtures composed of nicotine sulfate and soap in the usual proportions.

Air currents, denseness of tree growth, low temperatures and exudates of insects, such as wax and honeydew, exerted a greater adverse influence on the efficiency of dusting preparations than on that of spraying mixtures. These results suggest that while certain principles of procedure apply equally well to both systems of orchard treatment, the field technique required for effective dusting differs in important particulars from standard spraying practices. In its present stage of development dusting displays defects both as to methods of application and machinery which will probably be overcome by the corrective processes of experience. A study of present dusting methods shows also that a distinction should be made between obvious limitations of dusting materials and machinery and failures which arise from attempting to dust under conditons that are unfavorable for effective work. In the foregoing experiments operations which proved promising when no breeze was stirring and when the trees had open tops would not infrequently yield quite different results when strong air currents prevailed and the tree growth was dense. The inefficiency of dusting was most marked with the pear psylla and the woolly aphis, as the honey dew and waxy secretions of these insects were repellent to the materials. It was also noted that during periods of low temperature dusting was less effective than when high temperatures prevailed.

Our experiments show clearly that, while dusting has possibilities, it is not wise with our present knowledge and experience to encourage too great expectations as to the practicability of combating common sucking insects by this system of treatment. Growers who possess dusting machinery and do not consider present prices for contact insecticides prohibitive, might well conduct an experiment against the apple redbug. To attempt very large operations against other species of sucking insects would expose the growers to the risk of great expenditures for materials and large losses in fruit yields through inefficient control.

If the data make one point clear it is that dusting for sucking insects is in its first phase. While many failures have been noted in our experiments, we should be ignoring the history of scientific progress if we relied too much on early negative indications. The conservative as well as the constructive view to take is that conditions have passed the stage where dusting is considered wholly impracticable to one where it may be regarded as having possibilities under certain conditions. It remains to be seen whether this system of treatment will enter the realm of practical fulfillment of all the requirements and needs of the commercial orchard. It will take time and money, but it is well worth doing and needs to be taken up by those with special aptitude and necessary funds and equipment.

Improvements in Machine Construction

The conspicuous results obtained by dusting are speed of operation and economy in labor. It is presumed that dusting machinery is in the experimental stage and, if so, improvements will unquestionably be made that will meet the requirements of different field crops and various bush and tree fruits. It is also not unreasonable to hope that for the treatment of large trees outfits will be available which will insure satisfactory distribution of materials without sacrificing speed.

With such pests as redbugs and aphids, effective results will depend on the thorough coating of the insects. In dusting large trees it has been difficult to obtain satisfactory control without incurring large expense for dosage, which appears excessive in comparison with the cost of labor or for like materials used in spraying. In considering the items that enter into this expense, the fact stands out clearly that contact insecticides in powder form now prepared and sold by commercial companies are expensive and almost prohibitive for large operations. On the other hand, with existing types of orchard dusting outfits there is danger of applying excessive amounts to insure thorough treatment, and every pound in excess of actual requirements for effective work multiplies rapidly the cost of the operation. It is evident, then, that

while seeking to reduce the cost of insecticides encouragement should also be given to improving machinery which will insure both thorough and economical distribution and thus produce maximum benefits with minimum dosage. I merely wish to emphasize the practical bearing of this phase of the problem. I have not attempted to suggest modifications, but the improvement of machinery to meet the requirements of different crops needs serious attention.

Chemical Assistance in the Investigation of Dust Mixtures

In considering materials for dusting to combat such insects as aphids, capsids, etc., it should be noted that there is not a wide range of available substances with desirable insecticidal properties. At present nicotine sulfate is widely used, and is certainly the most effective constituent of dust mixtures which function as contact insecticides. A serious drawback to its extensive employment for this purpose is its high cost, and besides it has not always been available in sufficient quantities for commercial operations. The situation reveals a great need of more knowledge concerning the insecticidal properties of other substances, as there are doubtless various organic compounds equal to nicotine in value.

What is true of organic substances holds equally well with inorganic compounds. There is probably a large range of chemical agents which could be prepared in commercial quantities as soon as their properties are known and a need created for them.

Mention is made of these facts in order to focus attention on the promising field that awaits investigation and to emphasize the great need of cooperation between entomologists and chemists. Entomology is greatly handicapped by a lack of chemical assistance. In plans for the development of efficient dusting preparations it is not sufficient to have expert assistance in the quest for new insecticides only. It is also highly important to have technical knowledge relative to the physical condition of the materials used and of the influence of the physical properties on the effectiveness of the substance as an insecticide, since this is dependent upon factors other than its mere chemical composition. The difficulties that beset the dusting problem plead loudly for more constructive efforts along these lines and for a sharpening of the weapons of the entomologist.

Conclusion

In conclusion, this symposium, attracting as it does workers from the fields of phytopathology and entomology, constitutes a significant step, probably more important than is generally realized. The discussions should bring up new points of view and yield keener analyses of methods

and policies, and to that extent should promote a sane solution of the problem of dusting for the control and suppression of crop pests. The task is admittedly not a simple one. It is the usual experience, however, that difficulties lessen as we approach them with open minds, show a disposition to be fair, and a determination to reach the result which the facts rather than our predilections require. The collection and tabulation of existing experimental data will form the foundation upon which subsequent progress will be built. We may hope, therefore, that the future will bring order out of the chaos of conflicting opinions which exist with respect to a large field of significant data. The program may seem ambitious, but responsibility for action largely rests with the scientific workers in the two branches of effort. Ours is the task to create a stimulus and arouse an interest which shall bear fruit in practical endeavor.

PRESIDENT W. A. ORTON: Mr. T. J. Headlee will now discuss his experiences with Dusting to control Sucking and Biting Insects, with special reference to the plum curculio and the codling moth.

DUSTING AS A MEANS OF CONTROLLING INJURIOUS INSECTS[1]

By THOMAS J. HEADLEE, Ph.D., *New Brunswick, N. J.*

Late in the year 1912 the writer reached the conclusion that the development of powdered arsenate of lead and of finely divided sulfur had reached a point where further experiments on the relative value of dusts and sprays for control of insects injurious to apple and peach should be undertaken. In cooperation with Mr. F. H. Pough of the Union Sulfur Company and Mr. C. D. Vreeland of the Vreeland Chemical Company, a plan for attacking this problem was worked out and at the Cleveland Meetings of this society this plan was gone over and modified by Mr. F. M. Blodgett, Dr. Reddick and Dr. Whetzel of the Cornell Agricultural Experiment Station. This plan involved similar tests in certain of the Experiment Stations of the United States east of the Rocky Mountains, selected from the standpoint of the fruit growing industry. This plan included a test of a dust composed of finely divided sulfur and powdered arsenate of lead as compared with the same materials delivered in suspension in water and as compared with the standard commercial liquid treatments for the crop in question. The idea of

[1]Paper 18 of the Technical Series, N. J. Agricultural Experiment Stations, Department of Entomology.

delivering the same materials used for dust in a water suspension was carried out in New Jersey fully only the first year.

An experiment on apple and another on peach was undertaken at Glassboro and still another on peach at Vineland. The difference between the experiments at Glassboro and at Vineland lay in the fact that at Glassboro an effort was made to maintain a coating of the dust throughout the period of insect attack, while at Vineland no more applications of dust were made than were made of liquid spray. On peach both at Glassboro and at Vineland excellent control of both diseases and insects was obtained, but the foliage in both instances was so severely burned that the fruit never reached a satisfactory size.

In 1914 tests were again undertaken on peach at Vineland and on apple at Cranbury. Again the control obtained by dust on peach at Vineland was excellent, but the damage done to the foliage was so severe as to prevent the fruit from reaching proper size for market.

By 1917 a corrective for foliage injury, due to this dust mixture, had been found in the form of hydrated lime. The Horticultural Department of the Station undertook an extensive test of the relative value of sulfo-arsenical lime dusts and self-boiled lime sulfur-arsenate of lead liquid sprays. The control of insects and diseases obtained in all three years of experiments and the freedom from injury found in 1917 was such as to make the New Jersey Station feel that further tests of this material upon peach were unnecessary. The sulfo-arsenical lime dusts have been recommended since that year as practically equivalent in efficiency to the self-boiled lime sulfur arsenate of lead liquid sprays.

The data relative to the efficiency of the sulfo-arsenical lime dusts as compared with the liquid treatments on peach are set forth in the following table:

Year	Location	Sound Fruit Percent.	Curculio Percent.			Scab Percent.		
			Check	Dust	Liquid	Check	Dust	Liquid
1913	Glassboro		29.1	4.4	5.5	22.2	0.0	0.0
1913	Vineland		70.3	43.3	31.6	51.9	14.8	6.4
1914	Vineland			3.68	3.88		3.86	19.69
1917	Haddonfield		no record			57.83	5.05	2.52
Average			49.7	17.12	13.66	43.97	7.90	9.53

On apple the results have been very different from those on peach and the New Jersey Station has not ever and is not now ready to recommend the sulfo-arsenical dusts as in any way equivalent to the liquid sprays in efficiency in control of insects injurious to that crop.

In 1919 the New Jersey Station undertook a set of experiments in an orchard very severely infested with codling moth and curculio. The blocks were laid out by the Acting Horticulturist and the Entomologist. The materials were applied by the orchardist with his own organization

and the data were taken on the picked fruit only by the entomologist in cooperation with the acting horticulturist and the plant pathologist. No checks were left in this set of experiments.

In 1920 a plan of further testing the relative efficiency of the sulfo-arsenical dusts and liquid sprays was prepared in conference with Mr. P. J. Parrott, Mr. C. R. Crosby, Dr. W. E. Britton, Mr. H. E. Hodgkiss, Mr. S. W. Frost and the writer. It was proposed that tests according to this plan should be placed in Connecticut, New York, Pennsylvania and New Jersey. The Entomologist enlisted the cooperation of the Acting Horticulturist and the Plant Pathologist of the New Jersey Station. The apple blocks were located near Moorestown. The applications were made by the Acting Horticulturist and the Entomologist. The data were taken by the Plant Pathologist and the Entomologist. The following table will serve to set forth the results obtained from the 1913, 1914, 1919 and 1920 experiments.

Year	No. of Expts.	Location	Sound Fruit			Curculio			Codling Moth Total		
			C	D	S	C	D	S	C	D	S
1913	1	Glassboro									
1914	1	Cranbury							4.7	4.1	2.7
1919	1	Moorestown					20.	9.5		65.	30.3
1920	1	Moorestown	58.5	73.7	97.45	28.3	19.8	7.1	11.6	8.8	4.1

	Codling Moth									
	First Brood			Second Brood			Scab			Legend
	C	D	S	C	D	S	C	D	S	C = Check
1913							68.6	46.4	36.4	D = Dust
1914							33.	14.1	16.8	S = Spray
1919		15	7.4		50	22.9		22.	61.4	
1920	4.2	1.4	1.5	7.4	7.7	2.5	3.7	2.	1.5	

Examination of this table shows that in the 1913 tests no data on either curculio or codling moth were obtained because there was not enough of either insect to give results. In 1914 the curculio was not sufficiently abundant to give data and the codling moth on the untreated trees attack only 4.7 percent. of the total fruit.

In 1919, however, there was an abundance of both codling moth and curculio and in 1920 the curculio was present in large numbers and the codling moth in fair numbers.

Examination of the data, as set forth in this table indicates at once that the control of codling moth and curculio obtained by the use of the sulfo-arsenical dusts could not compare with the results obtained by the liquid sprays.

In view of the fact that Professor Whetzel, in his address to the New York State Horticultural Society at Rochester last year, presented large accumulations of data from Nova Scotia, New York, Michigan and Illinois in which he showed that the control of codling moth obtained by

use of the dust was, at least, as good as that obtained by liquid sprays, the writer has given considerable thought to the possible reason for the wide difference in the findings as reported by Professor Whetzel and the facts as derived from the New Jersey experience.

The fact that the codling moth in Nova Scotia, New York and Michigan shows either one brood or one and a partial second may have a good deal to do with the apparently better results obtained with dust in these areas, because the period during which the fruit must be protected is scarcely more than one-half of the time during which the fruit must be protected in New Jersey where two full broods of that insect are developed, but this will not hold in making comparisons of results obtained in Illinois, for in that state there are also two full broods of the codling moth.

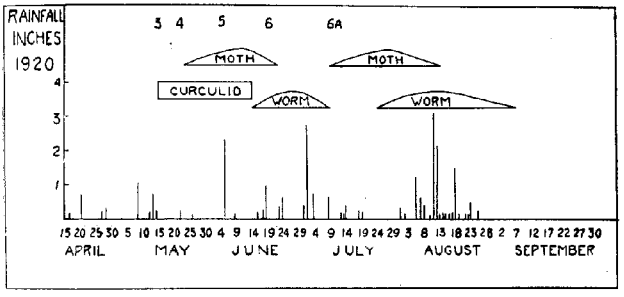

Fig. 4. Chart showing relation between rainfall, the occurrence of the codling moth and curculio and the time of spraying.

In Illinois, however, the normal annual rainfall is about 10 inches less than it is in New Jersey and theoretically the washing to which the dust applications would be subjected in that state would be materially less than that to which they would be subjected in New Jersey. The total rainfall in any year, or in any month is not a really trustworthy guide to the effect of the same upon the efficiency of dust applied mixtures, except insofar as the same indicates that the distribution during the dusting period is such as promptly to wash off the applications. In studying the effects of rainfall it is, therefore, necessary to study the distribution of daily precipitation during the periods when the dust must protect the fruit from the attacks of the codling moth.

Such a study has been made under New Jersey conditions for the year 1920. The season started late that year and the emergence of the first brood of moths and the entrance by the larvae covered materially shorter periods than in 1919. An average of 2.8 pounds of dust were

given to every tree in the dusted blocks on June 19 just after worm entrance began. This application experienced only three rainfalls until July 1st. The first of these three rainfalls was about .25 of an inch, the second was about .51 of an inch and the third was .4 of an inch. Furthermore this application of dust was made the day following a rainfall of .75 and this may have something to do with causing the dust to stick to the foliage more effectively than if applied during a dry period. Furthermore, it is probable that the period of entry being bunched because of the lateness of the season had largely occurred by July 1st, when a rain of 2¾ inches fell completely removing the dust from the trees. Under these conditions, the control obtained with the dust was as good as that obtained with the spray.

On July 9th the trees in the dusted block received an average of two pounds each and those in the sprayed block 7.5 gallons each. This spray was applied according to schedule and as can be seen from consulting the chart occurred much earlier than it should have. As a matter of fact, application 6 A should have been given about July 24th. Following this application of July 9th there were seven rains preceding August 6th when a rain of 1.1 inches fell followed at very frequent intervals by rains of considerable size, one of which amounted to 3.1 inches. The entrance of side worms began about July 25th and 26th and from that date on to August 6th, a matter of 11 days, it is fair to assume that the dust was still on the trees in sufficient quantities to be an effective factor in control.

From August 6th on to near the end of the month, a period of about 25 days, it is fair to assume, in view of the rainfall, that the dusted trees were practically unprotected. As a matter of fact, the dust exerted less than one-half as much control of the codling moth of the second brood as did the spray.

Thus there appears a definite relation between the effects of the dust and the distribution of the rainfall. It is also evident that the only way in which the effect of rainfall can be evaluated is to know not only the daily distribution of rainfall, but its daily distribution in relation to the period covered by entry of the codling moth worms of the first and second broods.

No data with which the writer is familiar has shown decidedly as satisfactory a control of the plum curculio on apple as has the liquid spray, but the amount of data available on control of this insect by dust applications on apple, taking the country as a whole, is decidedly limited. There is no reason, known to the writer, to indicate that the effect of rainfall on dust applications for codling moth will not apply with equal force to dust applications for curculio. This relative ineffectiveness

of the dust for control of curculio is certainly true under the average New Jersey experience, not only on apple, but also to a less extent on peach.

If the rainfall is, as it seems to be, a limiting factor in the effectiveness of dust applications as they are at present made, and if distribution of rainfall is such as to minimize the effect of dust applications by washing them from the tree, the writer thinks it entirely fair to conclude that the dust applications for control of curculio and codling moth are not as certain to give good results even in territories of low rainfall (for even in such areas the distribution may in any year wash off the dust at critical times)as are liquid sprays.

Speaking from the standpoint of peach growing in New Jersey, the writer wishes to say that he regards the sulfo-arsenical lime dusts as nearly equivalent to the self-boiled lime sulfur arsenate of lead liquid sprays, but that in dealing with apple growing he regards the sulfo-arsenical dusts as not comparable in efficiency with the liquid sprays and that he can recommend them only as an adjunct where for any reason the liquid spray cannot be applied.

During the season just passed certain data on the effect of nicotine carrying substances upon apple leaf hopper and apple plant lice have been collected with a view to seeing whether dust applications could not be used for the control of these insects. The following table will serve to show the effect of a 90–10 sulfo-arsenical dust impregnated in one case with .5 of one per cent. nicotine, in another case with 1 per cent. nicotine and still another case with 3 per cent. nicotine as compared with a commercial lime sulfur (1 to 40) liquid spray, to which nicotine has been added at the rate of ¾ of a pint to 50 gallons.

Examination of the following table on leaf hopper results shows that the 90–10 dust impregnated with 1 per cent. nicotine is as effective as that charged with 3 per cent. and only a little more than one-half as effective as the liquid treatment.

Date	Block	Row	No. of Leaves	No. of Hoppers	Killing Agent
6–8–'20	1	2	1,000	15	Nicotine 5 percent. applied
"	2	2	1,000	7	" 1% "
"	3	1	1,000	7	" 3% "
"	3	3	1,000	32	" 3% possible floating
"	4	2	1,000	76	Owner's treatment
"	5	2	1,000	4	Nicotine ¾ pts. to 50 gallons
"	4	Checks	1,000	108	None
		FROM DEMONSTRATION BLOCKS AT MAPLE SHADE			
6–8–'20	Original infestation estimated		3,000	9,000	
"	Row 3 Extension Specialist		3,000	90	Nicotine ¾ pts. to 50 gallons
"	Row 8 Experimentalist		3,000	25	Nicotine ¾ pts. to 50 gallons
"	Row 13 Owner		3,000	299	Nicotine ¾ pts. to 50 gallons

The following table will serve to show the comparative effects of a 90–10 sulfo-arsenical dust impregnated with .5 of one per cent. nicotine;

1 per cent. nicotine in another case and 3 per cent. nicotine in still another case in comparison with the effect of three-fourths of a pint of nicotine to 50 gallons of commercial liquid lime sulfur spray, both of the delayed dormant and summer dilutions.

Date	Block	Rows	No. of Buds	No. of Lice	No. of Lice per Bud	Species of Lice	Killing Agent
							Nicotine
4-24-'20	1	1–4	200	27	.13	Aphis avenae	Dust, 5%
"	2	1-4	200	17	.085	" "	" 1%
"	3		No counts				" 3%
"	4	1–4	200	76	.38	" "	L—S 1 to 40
"	5	1-4	200	10	.05	" "	L—S 1 to 40 Nicotine 40% ¾ pts. to 50 gals.
4-29-'20	1	1–4	200	39	.19	" "	Dust .5%
"	2	1–4	200	10	.05	" "	" 1%
"	3	1 & 2	200	1	.005	" "	" 3%
"	4	3 & 4	200	9	.045	" "	L—S 1 to 40 Nicotine 40% ¾ pts. to 50 gallons
"	5	1 & 3	400	0	0 0	" "	L—S 1 to 40
"	5	2 & 4	400	0	0.0	" "	L—S 1 to 40 Nicotine 40% ¾ pts. to 50 gallons

The first section of the above table shows the comparative results of nicotine impregnated 90–10 dust and the delayed commercial lime-sulphur nicotine spray on the oat aphis but gives no data whatever of their relative effects upon the eggs because practically all specimens had hatched before the delayed dormant applications were made.

Both the first and second sections show, however, that while recently hatched aphids are more efficiently reduced by liquid treatments the 90–10 dust impregnated with one percent. or more of nicotine do very material execution indeed.

PRESIDENT W. A. ORTON: The next paper is by Mr. A.L. Quaintance.

DUSTING VERSUS SPRAYING OF APPLES

By A. L. QUAINTANCE, *Entomologist in Charge Fruit Insect Investigations, Bureau of Entomology*

Different workers have recently rather fully summarized results of dusting apple orchards in comparison with spraying and reference to these experiments is here unnecessary, even were the time allotted me sufficient for this purpose. It is also quite unnecessary to dwell on the advantages, if effective, of dusting over spraying of orchards, since these advantages have been frequently pointed out and are furthermore perfectly obvious to any one experienced in orchard work.

It is the purpose of the present brief note to present in tabular form some results obtained by the Bureau of Entomology and Bureau of Plant

Industry during the last few years in dusting of apple orchards in comparison with spraying. The results in so far as relating to details lack much in definiteness and present frequent inconsistencies, but perhaps not more so than happens in experimental work of this character. The work was accomplished for the most part in a thorough-going and effective manner by men experienced in this kind of experimentation. In one or two instances the arrangement of plats in the experimental blocks was not entirely satisfactory, since it was not possible to obtain orchards of sufficient size. and of the right varieties to obviate some overflow of dust from one plat to another. No attempt will be made to draw detailed conclusions, as for instance, on the proper dosage of arsenate of lead, the matter of diluents, number of applications, etc. Certain general conclusions however appear to be warranted, which will be given below.

Table I gives results of dusting versus spraying apples at Benton Harbor, Mich., carried out under the direction of Mr. F. L. Simanton during the years 1915, 1916 and 1917, involving varieties of Rhode Island, Ben Davis and Baldwin. In some of this work Mr. Simanton was assisted by Mr. H. G. Ingerson and Mr. A. J. Ackerman, of this Bureau and Mr. Leslie Pierce, of the Bureau of Plant Industry.

In Tables II and III results are presented from Winchester, Va. of dusting versus spraying of apples during 1917 and 1918, carried out by Mr. B. R. Leach, of this Bureau. During 1917 scab results were not taken on the York Imperial, nor in 1918, since this variety is very little subject to this disease. Results on scab infection for 1918 however are shown in the case of Ben Davis variety.

Table IV presents results of dusting versus spraying of apples at Bentonville, Ark., during 1918, carried out by Mr. A. J. Ackerman, of this Bureau, and assisted by Mr. Leslie Pierce, of the Bureau of Plant Industry. In this work, in addition to results on codling moth and curculio, the effect of the treatments on apple scab and apple blotch was secured.

Table V presents work accomplished at Wallingford, Conn., during 1918, carried out by Mr. E. H. Siegler and Mr. B. A. Porter on McIntosh and Baldwin varieties. Scab results were taken on the McIntosh variety, but as will be noted from the figures, there was practically no scab present.

Table VI presents results of dusting versus spraying of apples at Grand Junction, Colo., on the Ben Davis variety during 1917. This work was carried out by Mr. L. C. Antles and H. K. Plank of this Bureau. Results on the codling moth only are presented, since in this arid region fungous diseases of the fruit are of no importance.

TABLE I—DUSTING VS. SPRAYING APPLES—BENTON HARBOR, MICH.

1915—Rhode Island Greening

Plat No.	Materials[1]	Percent. fruit free from		
		Codling moth	Curculio	Scab
I—Liquid	A. L. 1-50; L. S. 1-½-50	96	94	95
II—Dust	A. L. 10%; S. 40%; L. 50%	95	87	73
III "	A. L. 15%; S. 40%; T. A. 45%	96	94	71
IV "	A. L. 25%; S. 75%	97	89	75
V—Check	No treatments	75	82	39

Above treaments given for calyx and subsequent applications—For "pink spray" the following were used: Plat I—L. S. 1-½-50; II and III, S. 50%; L. 50%; IV, S. 75%; L. 25%.

1915—Ben Davis

I—Liquid	A. L. 1-50; L. S. 1-½-50	97	94	98
II "	" "	97	91	98
III—Dust	A. L. 10%; S. 40%; L. 50%	98	92	49
IV "	A. L. 15%; S. 40%; T. A. 45%	97	93	53
V "	A. L. 25%; S. 75%	97	90	70
VI Check	No treatments	91	87	16

Above treatments given for calyx and subsequent treatments. For "pink spray" following were used: Plats I and II, L. S. 1-½-50; III and IV, S. 50%; L. 50%; V, S. 100%.

[1]A. L.—Arsenate of lead L. S.—Lime sulphur. S.—Sulphur. L.—Lime. T. A.—Terra Alba.

1916—Ben Davis

Plat No.	Materials	Percent. fruit free from		
		Codling moth	Curculio	Scab
I—Liquid	A. L. 1-50; L. S. 1-½-50	97	85	83
II—Dust	A. L. 5%; S. 50%; L. 45%	90	50	15
III "	A. L. 10%; S. 65%; L. 25%	97	86	17
IV "	A. L. 15%; S. 75%; L. 10%	99	92	29
V "	A. L. 20%; S. 80%	98	89	21
VI—Check	No treatments	65	47	10

Above treatments given for calyx and subsequent applications For "pink spray" following were given: Plat I, L. S. 1-½-50; II, S. 50%, L. 50%; III, S. 65% L. 35%; IV, S. 75%; L. 25%; V S. 80%; A. L. 20%.

1916—Baldwin

I—Liquid	A. L. 1-50; L. S. 1-1½-50	91	85	84
II—Dust	A. Lime 7.5%; S. 60%; L. 32.5%	85	84	34
III "	A. L. 10%; S. 65%; L. 25%	91	87	37
IV "	A. L. 15%; S. 75%; L. 10%	94	89	39
V "	A. L. 25%; S. 75%	94	87	55
VI—Check	No treatments	51	76	22

The above treatments given for calyx and subsequent applications. For "pink spray" the following were used: Plat I, L. S. 1-½-50; II and III, S. 65%, L. 35%; IV, S. 75%, L. 25%; V, S. 80%; A. L. 20%.

1917—Baldwin

Plat No.	Materials	Percent. fruit free from		
		Codling moth	Curculio	Scab
I—Liquid	A. L. 1-50; L. S. 1-½-50	87	83	95
II—Dust	A. L. 10%; S. 65%; L. 25%	84	88	61
III "	A. L. 15%; S. 85%	80	84	62
IV "	A. L. 15%; S. 75%; L. 10%	94	89	80
V "	A. L. 33%; S. 67%	92	90	87
VI—Check	No treatments	50	89	32

Above treatments given for calyx and subsequent applications. For "pink spray" following were used: Plat I, L. S. 1-½-50; II, S. 65%, L. 35%; III, S. 100%; IV, S. 85%, L. 15%; V, S. 67%; A. L. 33%.

TABLE II—DUSTING VS. SPRAYING APPLES, WINCHESTER, VA. 1917

Plat No.	Treatment Calyx; 3–4 weeks later; 8–9 weeks after calyx	Ben Davis	York Imperial	York Imperial
		Percent. free from		
		Codling moth	Codling moth	Codling moth
I—Liquid	A. L. 1-50; L. S. 1-½-50	99	97	98
II—Dust	A. L. 15%; S. 50%; L. 35%	99	97	99
III "	A. L. 15%; L. 85%		96	99
IV—Check	No treatments	69	46	67

TABLE III—DUSTING VS. SPRAYING APPLES, WINCHESTER, VA., 1918

Plat No.	Treatment Calyx; 3–4 weeks later 8–9 weeks after calyx	Ben Davis		York Imperial
		Per cent free from		
		Codling moth	Scab	Codling moth
I—Liquid	A. L. 1-50; L. S. 1-½-50	96	92	98
II—Dust	A. L. 10%; S. 50%; L. 40%	95	54	98
III "	A. L. 15%; S. 50%; L. 35%	98	—	97
IV "	A. L. 15%; L. 85%	—	—	91
V Check	No treatments	54	34	81

TABLE IV—DUSTING VS. SPRAYING APPLES, BENTONVILLE, ARK., 1918

Ben Davis

Plat No.	Pink Spray	Calyx and later treatments, 5 in all	Per cent. free from			
			Codling moth	Curculio	Scab	Blotch
I—Liquid	L. S. 1-½-50	A. L. 1-50; L. S. 1-½-50	69	87	89	91
II—Dust	S. 85%; L. 15%	A. L. 15%; S. 85%	30	87	64	79
III—Check	No treatments		27	60	10	84

TABLE V—DUSTING VS. SPRAYING APPLES, WALLINGFORD, CONN. 1918

McIntosh

Plat No.	Pink Spray	Calyx treatment (only two applications made)	Percent. free from		
			Codling moth	Curculio	Scab
I—Liquid	L. S. 1-½-50	A. L. 1-50; L. S. 1-½-50	97	84	99
II—Dust	S. 50%; L. 50%	A. L. 10%; S. 50%; L. 40 %	98	84	99
III "	S 75%; L. 25%	A. L. 10%, S. 75%; L. 15%	98	85	99
IV—Check	No treatments		94	62	99

Baldwin

I—Liquid	L. S. 1-½-50	A. L. 1-50; L. S. 1-½-50	99	72
II "		A. L. 1-50; L. S. 1-½-50	99	74
III—Dust		A. L. 5%–S. 50%; L. 45%	99	65
IV "	S. 75%; L. 25%	A. L. 10%; S. 75%; L. 15%	99	71
V "		A. L. 10%; S. 50% L. 40%	99	61
VI "		A. L. 15%; S. 25%; L. 60%	99	63
VII—Check	No treatments		92	27

TABLE VI—DUSTING VS. SPRAYING APPLES, GRAND JUNCTION, COLO. 1917

Ben Davis

Plat No.	Treatment calyx, and subsequent applications. Six in all	Per cent. fruit free from codling moth
I—Liquid	A. L. 1-50	62
II—Dust	A. L. 20%; L. 80%	40
III "	A. L. 15%; L. 85%	34
IV "	A. L. 10%; L. 90%	14
V—Check	No treatments	8

From the Bureau's experiments in dusting versus spraying of apples, as indicated above, and from considerable observation on this work it is

felt that the following general conclusions in regard to the codling moth and plum curculio are warranted.

In regions where the codling moth is not especially severe, as in the New England States and other more northern States, dusting controls this insect practically as well or as well as spraying. In regions where the codling moth is more abundant, due to a larger second brood or to subsequent broods of larvae, as in Maryland, Virginia, Illinois, the Ozarks, etc., dusting is not a satisfactory control. In such arid regions as the Grand Valley, Colo., where the codling moth is very prolific and injurious dusting is notably less effective than spraying.

In the case of the plum curculio on apples, dusting compares favorably with spraying where the insect is not especially abundant. Under conditions of curculio abundance, as is often the case in orchards in sod, dusting is not an effective control for this insect and spraying under these conditions may not furnish the protection desired.

The results given in the tables on the control of scab, brown-rot, and apple blotch are presented for the consideration of Pathologists interested in the subject. In reference to comparative merits of dusting and spraying in apple disease control, Prof. Waite has recently expressed himself as follows (Annual Report, Bureau of Plant Industry, for the fiscal year ending June 30, 1920, page 61):

> Comparative tests of dusting and spraying methods were continued in both peach and apple orchards. In the case of the peach the tests were particularly severe, and neither spray nor dust gave as good control of brown-rot as was expected. The dust was about as efficient as the spray. In the case of the apple, as in previous years scab black-rot, leaf-spot blotch, sooty blotch and bitter rot were not controlled by dusting. To the list of diseases almost entirely prevented by spraying but not controlled by dusting was added the New Hampshire fruit-spot, which was especially destructive in the Ozarks, where our experiments were carried on.

Dusting Versus Spraying of Peaches

Considerable work has been done in dusting peaches in comparison with spraying for the control of the plum curculio, scab and brown-rot in different parts of the country, but little of this work has been entirely satisfactory from the experimental standpoint owing to the scarcity in the same orchard of one or more of these troubles. The most conclusive results obtained come from Mississippi and Georgia and indicate that during periods of average abundance and under average weather conditions dusting is about as effective as spraying for these three peach troubles. It should be pointed out however that during the last two seasons in Georgia, where the weather has been unusually hot and rainy,

neither dusting nor spraying gave much benefit and there was a heavy loss of fruit in some parts in spite of very thorough dusting and spraying by the growers.

PRESIDENT W. A. ORTON: Problems of plant pathology beginning with truck crop diseases will be discussed by Mr. H. A. Edson of the Bureau of Plant Industry.

The discussion was informal and no paper was submitted.

PRESIDENT W. A. ORTON: The last paper is entitled "Problems Associated with the Control of Plant Diseases in Orchards," and will be presented by Mr. N. J. Giddings, Morgantown, W. Va.

ORCHARD DUSTING VERSUS SPRAYING

By N. J. GIDDINGS, *Morgantown, W. Va.*

In the few moments available I wish to present first a note regarding the use of dust on peaches; second a brief review of our own experiments with dust for control of apple diseases in West Virginia; third to give a more general survey of the work along that line; and fourth to submit a few home-brewed, and re-distilled statements for your kind consideration.

There seems to be no question as to the effectiveness of sulphur dust for the control of peach scab. In our experimental work the control with dust averaged a little better than with spray. Our data on brown rot control are rather inadequate because the amount of infection was light, but the results indicated that the dust was just about as effective as spray. The details of our work on peaches are given in West Virginia Experiment Station Bulletin No. 167. Some investigators have reported fruit and foliage injury from the use of sulphur dust on peaches, but we feel that this injury can be reduced to a negligible minimum in actual orchard practice in West Virginia. We found such injury only when excessive amounts of material were used.

The attractive features of dust applications were first brought to my attention in 1912–13. Professor Peairs, our entomologist having had experience with dusting, was favorably impressed with the method, and anxious to give it a further trial. I was at least reasonably optimistic, so our experimental work was undertaken with the most sincere hope of success, supplemented by the determination that the work should be thoroughly and carefully carried out.

Our first work was conducted in orchards where scab failed to develop sufficiently to warrant drawing any conclusions. For our later work we were very careful to select orchards in which this disease was prevalent.

In all of this work we have used the sulphur-arsenate dust, and during the past two seasons a number of special dusts have been tested. Among these were copper-lime dust, containing 20 percent. dehydrated copper sulphate and two percent. copper carbonate; copper-lime dust, containing 10 percent. dehydrated copper sulphate; copper-lime dust, containing 15 per cent. dehydrated copper sulphate and 15 percent. Venetian red; commercial Bordeaux dust (11 percent. copper) with an equal amount of hydrated lime; the preceding mixture with the addition of 2½ per cent. acacia; dry lime sulphur diluted with an equal amount of rye flour; and sulphur dust containing 14 percent. dry lime sulphur. Approximately 10 per cent. of lead arsenate was included in each of the foregoing mixtures. The Bordeaux dusts were used three seasons and the copper-lime dusts have been tried during the past two seasons.

Without definitely condemning any of the preceding mixtures it may be noted that the materials which gave best results were the copper-lime-Venetian red, and the sulphur-lime sulphur, with many points in favor of the latter. We plan to test this mixture (sulphur 75, lime sulphur 15, lead arsenate 10) again during the coming season and hope to try others of a somewhat similar character. We feel that the standard sulphur-arsenate mixture is a good base because of its physical properties and fungicidal action, but that some more active agent such as copper or the dry lime sulphur may prove to be a desirable constituent.

In all of our experimental work the 3–5–50 Bordeaux spray has been the most effective fungicide and the lime sulphur spray next in value. We believe that our data for the past two seasons were secured under conditions which warrant close comparisons, and that the results are reasonably reliable for the materials used. The equipment available and the climatic relationships of the particular regions in question must also be considered in connection with any data of this kind.

EXPERIMENTS IN 1919

	Check	Bordeaux spray	Copper-lime dust	Sulphur dust	Lime sulphur spray
Foliage data:					
Leaf spot (Percent. of leaves diseased)	78.1	52.9	61.5	60.8	35.0
Leaf spot (*spots* per infected leaf)	6.0	2.3	2.8	2.8	2.0
Percent of scabby leaves	75.4	61.3	68.8	69.8	61.5
Fruit Data:					
Percent. scabby fruit (total)	98.4	34.5	92.8	83.0	52.8
Percent. light scab	9.1	17.9	29.0	37.6	23.6

EXPERIMENTS IN 1920

(*Orchard No. 1*)

Foliage data:					
Percent. scabby leaves	80.4	1.8	60.1	23.2	23.3
Fruit data:					
Percent. scabby fruit (total)	91.1	31.3	80.5	77.9	46.0
Percent. light scab	20.0	17.8	35.3	34.3	28.3

(*Orchard No. 2*)

Foliage data:					Sulphur-lime sulphur dust
Leaf spot (Percent. leaves diseased)	80.0	32.9	60.4	46.4	26.4
Leaf spot (*Spots* per infected leaf)	20.8	2.8	5.0	3.5	1.7
Percent. scabby leaves	53.6	7.7	14.9	10.1	3.9
Fruit data:					
Percent. scabby fruit (total)	95.2	21.5	90.5	71.2	51.8
Percent. light scab	18.3	8.1	39.6	23.6	19.7
Percent. sooty blotch	99.5	5.0	89.9	79.8	54.2

Please note that the results from use of sulphur-lime sulphur dust are included merely because they indicate a hopeful line for further experimental work. The combination of natural conditions which helped to bring about these results may have been far from normal, but we are inclined to believe that such was not the case.

Our results have indicated that sulphur dust is not so effective as either the lime sulphur spray or the Bordeaux spray for control of apple scab in West Virginia orchards where the disease is severe.

We have found that it is absolutely essential to apply the dust in the early morning, and undoubtedly it would be preferable to apply it soon after midnight as some are already doing. We have found that the dust machines available do not have sufficient power and do not expel the dust with sufficient force. We believe that the discharge tube could well be arranged so as to give better distribution of the dust as it leaves the machine.

We have also found that applications of different materials must all be made on the same day if any comparisons are to be considered. We have a large amount of data, including special experiments, which shows that a difference of one to three days between the dates of application of various materials or between applications of the same material will often decrease or increase the relative effectiveness to such an extent as to indicate clear-cut success on the one hand and extreme failure on the other.

Turning now to a general survey of the work, I will endeavor to interpret it from my point of view. I hope to keep within reasonable bounds, for this idea of interpreting the other fellow's data is a very dangerous pastime. Considering, first, the 1920 season, Michigan and Virginia present strong evidence as to the value of sulphur dust against apple scab. In Virginia seven applications of material were given. It seems to me that we should reduce this number of treatments. Pennsylvania reports good results from dust in two orchards and just fair comparative control in a third. Five applications were given in each of these orchards.

The data secured in Connecticut are of particular interest, and the following figures are presented with due acknowledgments to Dr. G. P. Clinton and Mr. E. M. Stoddard.

PERCENTAGE OF SCAB IN PLOTS

Variety	*Check*	*Dust*[1]	*Spray*
Fall Pippin	56.3	48.9	7.75
McIntosh	37.25	13.79	1.08
Greening	10.85	1.17	0.48

These figures indicate that the dust was of far greater relative effectiveness where the amount of scab was slight than where the infection was reasonably severe. On the other hand we must keep in mind the fact that this experiment deals with different varieties, and there may be other factors which should be considered. In Pennsylvania Mr. R. C. Walton called attention to the fact that their results with dust in 1919 were strongly negative and that the amount of infection was high, while they secured far more favorable results in 1920 when the general scab infection was much less severe.

Nova Scotia, using four applications, and West Virginia, using three applications in one orchard and four in another, also give evidence which is distinctly unfavorable to sulphur dust.

It might be mentioned at this time that in comparing these data I have assumed that, if the sprayed plot gave over ten percent. more sound fruit than the dusted plot under similar conditions, the dust was comparatively inefficient.

The results reviewed for the season of 1920 are reasonably similar to those for previous seasons but the time will not permit further discussion.

Now I wish to present certain conclusions and suggestions based upon our experiences in connection with this work in West Virginia, and the available data from other sources. The problem itself should receive attention from three distinct angles (equipment, materials, and methods). I have already stated what we believe to be some of the more important improvements needed in the equipment for applying dust, and will not stop to discuss further details here. When it comes to the question of materials, I believe that we are grossly ignorant. Take for example the one material, *sulphur dust, when in contact with living plant tissue*, and consider the factors mentioned in the following questions, as to their influence on the fungicidal action, or the injuriously toxic properties of this dust.

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[1]This was the so-called "3 in 1" dust, containing three percent. of nicotine. The treated plots each received four applications

What is the effect of sunlight?

What is the effect of heat?

What is the effect of diurnal temperature variation?

What is the effect of moisture?

What is the combined effect of moisture and temperature variations?

Is there any consistent and pronounced difference in the action of this material upon different varieties or species of plant, and if so why?

Perhaps some of you are now convinced that the dusting problem has been too great a strain upon me, but let me assure you in all seriousness that our progress in phytopathology will eventually be based upon the correct answers to such fundamental questions. A reasonable knowledge regarding these factors will save many disputes and misunderstandings, and will explain many of those things which we, "are sure cannot be so," but which *are so.*

The above-mentioned questions must also be applied to dust combinations such as the sulphur-arsenate, copper-lime-arsenate, sulphur-lime sulphur-arsenate, and others. As already indicated, there are numerous other materials or combinations of materials which are worthy of consideration, and possibly of trial.

Methods of treatment and methods of handling results are also worthy of study. This is a field in which we should be able to agree to a reasonable extent. There has undoubtedly been a considerable and steady improvement in methods, but it must continue. New developments in equipment and materials will also have their effect upon methods of treatment.

There is a vast amount of work to be done. The field is large and no one institution will be likely to solve many of the problems involved. By reasonable co-operation the progress will be more rapid, but we will need abundant help from chemistry and physiology. In this case our problem is also the problem of entomology and horticulture and we know that their co-operation is assured.

There is a strong natural tendency to publish positive results and to avoid the publication of negative results. This is an unfortunate trait, for the negative data from a good investigation, well conducted, are of greater actual value than positive data from a similar investigation poorly conducted.

I believe that all of us should submit the results of our investigations to disinterested, but capable, parties who will give them their frank and careful criticism before we turn them over to the printer. I am certain that such action would prevent many unintentionally misleading statements which find their way into print.

Premature publication is common, while over-delayed publication is rare. The mere fact that sulphur-lime sulphur-arsenate dust gave us good results in 1920 is no warrant for me to recommend it as a practical treatment, and assume that it will prove effective in 1921 and 1922. Permit a digression here to state that one certainly recommends a material or a practice if he submits a favorable report with favorable conclusions to the general public who are likely to be influenced by it in their commercial operations. If we do not secure consistently favorable results during at least three successive seasons, I do not believe that we have any right to place suggestively favorable evidence before the consuming public. By disregard of any such rule one not only does an injustice to the horticulturist and the orchardist, but he actually injures the status of plant pathology to a very serious extent.

Let me quote from a couple of letters which happen to be from outside West Virginia but which describe the conditions in this state very accurately.

"We have a great many dust machines around among the growers but these machines are lying idle this year."

"For your information, I wish to state that the writer has personally used the dusting method in his own orchard during the years 1917 and 1918 upon apples at Springdale, Washington County, Arkansas, and the results that we got at that time were very disastrous, as were results of growers at Rogers and Bentonville of Benton County, Arkansas, during those two years."

I have recently talked with two of our largest and most progressive commercial apple growers and these men have suffered extreme losses as a result of their endeavors to control apple diseases (specifically scab) by the use of sulphur dust. They made numerous applications. They bent every effort toward accomplishing the desired end. They failed disastrously. Both have definitely abandoned any further attempts to use dust, and it will require extremely convincing evidence before we can ever induce them to take up dusting again, even in case improved machinery and new dust mixtures should be found effective. The seriousness of such a situation need hardly be pointed out, and we should spare no efforts to avoid things of this kind.

Personally, I am hopeful for the future of dust applications for the control of many orchard diseases. I do not believe that dust will entirely take the place of spray, but I do believe that it will eventually fall into line and will be accepted as the best method for control of certain diseases under certain general conditions. At the same time I am quite positive that there must be improvements made in the machinery and in the nature of the dust applied before it can come into successful general use among apple growers.

President Newell assumes the chair.

PRESIDENT W. A. ORTON: Three points in particular I want to mention with respect to dusting for the control of both insects and plant diseases: First, that our outlook be from this time forward, and not backward,—toward the possibility of success in the future regardless of failures in the past; second, let us organize our work to bring to bear upon these problems the best help of all kinds of specialists concerned—entomologists, pathologists, chemists, engineers, and farmers; third, that our experimental methods should be adapted to the complexity of the problem.

With respect to this morning's discussion, it seems to me that it is not worth while for any of us to speak in the discussion upon our past failures unless we know the reason why. We have had lots of them. In the field of truck crop diseases the failures far outnumber the successes, but we do feel that the whole question of dusting ought to be reopened, because the fruit and truck growing industries demand that simpler and easier methods of disease control should be introduced.

I feel personally, particularly in our own field, the very great importance of concentrating the services of specialists in many different lines. We cannot as pathologists feel that we are planning our work properly unless we are advised as to the life history of the insects which have to be dealt with. We need the help of the chemist to determine the composition of our mixtures; we need the help of the plant physiologist to determine the reaction of the chemicals upon the plants; we need the help of the chemist to determine by actual analysis what amount of fungicides may be present upon the leaves, what amount is washed off by the rains, the relative adhesiveness of the compounds. We need the help of the engineer to plan better machinery for applying our fungicides and insecticides.

Our experimental methods, I feel, have not been planned correctly. One speaker has mentioned that results differ greatly if a short time intervenes between the applications that are being compared. One spray on one day and another three days later give different results. That is true, but are we not making a mistake in planning our experiments in the office in the beginning of the season and carrying them through on a fixed schedule regardless of developments during the season. When we plan to spray every two weeks, such and such a mixture, such and such quantities, are we not like the general in the war who says "I will fire my guns in the general direction of the enemy at ten o'clock on Mondays, Wednesdays and Fridays?" The chances are if he does so the enemy is still snugly protected in bomb-proof dug-outs, or has not yet come out in the field, or is forward in the skirmish line. Now we

are in a battle and our enemies, these diseases and insects, are not following any fixed dates. The insects emerge and lay their eggs and pass from one stage to another depending upon temperature and other conditions. Our fungi germinate their spores with reference to moisture and temperature. We, as experimenters, have got to know just when the critical stage is when we can deliver our broadsides most effectively. What we want to do is to put ourselves in the grower's place to work out a method of disease control and insect control that will be effective and cheaper than the present method. If that calls for six applications of dust or eight applications of dust when the standard number of sprays is three or four, let's do it that way. The real test of the relative merit of the two methods comes from the economic standpoint. Can we control insects and diseases more effectively and more cheaply by a method of dusting than by a method of spraying?

PRESIDENT WILMON NEWELL: The entire subject is now open for general discussion.

A MEMBER: I should like to ask Mr. Giddings with reference to the various dusts applied, whether the materials that were used to secure adhesiveness were successful. If so, which was the best?

MR. N. J. GIDDINGS: They were not particularly successful. The Venetian Red was used not particularly to secure adhesiveness but to help in carrying the material through. It gave evidence of other trouble in the machine which I do not think would warrant its use. The others we did not think were worth while.

MR. WILLIAM MOORE: I presume that in the experiments with nicotine dusts the half percent. of nicotine given is the total nicotine found in the dust. We all know the principle of the gas mask—a finely divided solid through which the air was drawn to the soldier; the poison gas never reached him, as it was adsorbed by the solid. Any solid which is finely divided and presents a large surface may adsorb certain liquids, gases or even other solids. In this particular case there is a possibility of the adsorption of nicotine, thus locking it up and making it unavailable. Another question is that nicotine sulphate itself is non-volatile. How was this loosened up? I don't suppose that the nicotine would become effective against the insect until at such time as it became volatile. You thus have two possibilities of reducing the amount of nicotine that was actually effective against the insect. When we consider the cost of nicotine it is not advisable to lock up any in such a way.

I wish to point out that different materials will give you different results. I know nothing about it, but would assume from the nature of the materials that a sulphur with nicotine added would have more

available nicotine than a clay with nicotine added, although you add the same amount of nicotine in each case.

I would like to know whether any experiments have been conducted with clays and nicotine as well as sulphur and nicotine.

MR. RUTH: Sulphur will volatilize by hydrolysis of water.

Mr. ALVAH PETERSON: I have some points along this line that may be of interest. During the past season we conducted experiments on various plant lice with nicotine impregnation in the various substances. For the most part we used different kinds of clay and impregnated these with varying amounts of nicotine sulphate. We found as Dr. Moore has suggested that when we made a two percent. mixture of nicotine sulphate in clay, we obtained, as I recall now, about the same killing effect as when we used a half per cent. of nicotine in clay with addition of ground stone lime. Hydrated lime did not give as good results as stone lime finely ground. We know that when lime is added to a nicotine compound such as nicotine sulphate, it liberates nicotine. This combination gave us a very effective dust for the potato aphis.

MR. WILLIAM MOORE: When you add lime to clay (clay is colloidal or almost collodial) it precipitates the clay, flocculates it, I believe they call it in soil chemistry. Precipitation reduces the surface and also the amount of the nicotine that can be adsorbed so you also have a freeing of nicotine from that source as well.

PRESIDENT W. A. ORTON: You know that we have been doing a whole lot of work lately on the mosaics, one of the most important groups of plant diseases, which are carried from field to field and plant to plant by aphids. It is manifestly evident that control of mosaic diseases is very largely dependent upon aphid control. We have been greatly interested to hear that dust combinations of nicotine with, I think, kaolin or lime are being introduced by the entomologists. I wish we might hear something about that from someone who has had experience.

MR. P. J PARROTT: I would say, Mr. Chairman, that the control of the potato aphis and the potato leaf-hopper by dusting is largely in the experimental stage, and the situation with regard to these species is not very different from that of the apple aphids, redbugs and other insects which I considered in my paper. The potato aphis and leafhopper nymphs are susceptible to dusting preparations containing nicotine. But the selection of insecticides is only one factor of the problem, and as far as these insects are concerned there is a serious need of machinery capable of dusting the undersurfaces of potato foliage, as well as data on the effectiveness of this system of treatment in controlling the common potato diseases. Thorough applications of dust kill a large percent-

age of the aphids, but it is interesting to note that the potato aphis proved, in our experiments, to be more resistant to dust mixtures with nicotine than the apple species. Preparations with two percent. nicotine are expensive, and the cost makes the treatment impractical except for experimental operations. In addition to encouraging improvements in machinery, experimental workers should lend their efforts to the production of cheaper insecticides and fungicides in dust form. The future progress of dusting truck crops depends to a large extent on the solution of these problems.

PRESIDENT W. A. ORTON: We have to deal not only with the potato, but other crops. Spinach blight, so-called, is a mosaic disease very prevalent in Virginia, Ohio, and other states. The aphis spreads the spinach mosaic and ought to be controlled. Cucumber mosaic, the principal limiting factor in the pickle industry of the Great Lakes States, is spread mainly by aphids. If we can have effective methods of aphis control of cucumbers, we can pretty nearly revolutionize the cultivation of cucumbers for pickles. Potato mosaic is getting more abundant every year and new hosts of mosaics are constantly brought to our attention. It is likely that there is insect transmission in all cases, consequently the men who are experimenting with means for destroying aphids have a big work cut out for them, and an opportunity to do a very large service in the control of plant diseases.

MR. MCCLINTOCK: I would like to ask the entomologists a question. Certain agents, who are selling dusts at the present time for the control of insects in peaches, state that the sulphur in the dust has some repellent action as far as curculio are concerned. I would like to have that question answered, and further if there would be any advantage in a dust, in having the nicotine, as a repellent to the curculio.

MR. A. L. QUAINTANCE: I think that dust on the peach tree might have some repellent action. I don't think it would be sufficiently repellent to afford protection from the curculio. I doubt if the nicotine would be of very much value, not enough to warrant its cost. The treatment for curculio is arsenate of lead.

MR. L. R. TAFT: We were very properly warned by the Chairman against stating premature conclusions. I wish to state my conclusions after thirty years' experience with dusting and spraying carrying them on in an experimental way, and also watching the results obtained by practical fruit growers.

I am convinced that in Michigan, at least, we can get practically as good results against curculio and the codling moth with the arsenical dusts as with the ordinary sprays, but we fail when using dust against

the different aphids, red bugs and similar insects. When used against fungous diseases the results have been less satisfactory, and regarding the use of dust for apple scab and similar fungi, I agree perfectly with Dr. Headlee in his conclusions, and have advised Michigan fruit growers to "spray when you can for the apple scab, and when you cannot spray, dust."

In Michigan, many of our best fruit growers are becoming very enthusiastic over dusting for apple scab. They had sprayed for years with Bordeaux or lime-sulphur solution but in some seasons had russeted the fruit badly with Bordeaux mixture, and had burned the leaves, especially in hot weather, when they had used lime-sulphur sprays. For the last four years, the weather in the southern part of the State has been comparatively dry during the spring and early summer and they have been able to control apple scab practically as well with the ordinary sulphur dust as with lime-sulphur sprays. In the northern part of the State, where the weather has not been as warm, and where rains have been more frequent, the results have been less satisfactory. We visited one forty acre orchard containing mostly Baldwin and Northern Spy trees in July and again in August, 1920, which had received three applications of dust. One was given when the trees were in the pink; the second immediately after the fruit had set; and a third two weeks later. The fruit was so badly infested with apple-scab that the owner considered the crop worthless for packing and sold the entire 20,000 bushels for cider. The results were not unlike those secured in Michigan by Dr. Quaintance in 1916 in an experiment carried on at Benton Harbor under the direction of Professor Simanton. The Ben Davis and Northern Spy apples upon which dusts were used were quite badly infected with scab, while the sprayed trees were practically free from that disease. They also agreed with those secured by Mr. Dutton of the Michigan Experiment Station in 1915. Although the trees were very carefully dusted, when the crop was harvested, it was difficult to note any difference between the dusted and the check trees. In 1915, the season in Michigan was very wet, there being some twenty-six rainy days during the month of July. Frequent rains in 1916 also had much to do with the development of apple scab upon the Benton Harbor orchard reported by Dr. Quaintance.

From the fact that dusting is a rapid method of treating the trees, a large number of Michigan fruit growers with orchards of from 20 to 100 acres are now relying almost entirely upon their dusting machines except for their dormant sprays. They have been well satisfied with the results secured in dry seasons but we fear that they will not be so successful in controlling the apple scab and other fungous diseases in wet seasons

which they are likely to have at any time. For this reason, while we advise all fruit growers having extensive orchards to procure a dusting machine, we believe that it should be used to supplement the spray rig and to aid in supplying a fungicide to the trees when weather or other conditions make it impossible to provide fungicides for their protection in a liquid form. Our experience leads us to believe that whether or not success against fungi can be secured with dusting will be determined by the character of the weather.

MR. WILLIAM MOORE: Some one has said that nicotine sulphate is not volatile, pointing out that it hydrolyzes and was then volatile. When it hydrolyzes it is no longer nicotine sulphate. Nicotine sulphate is not volatile.

MR. RUTH: I made that statement. It does hydrolyze and the nicotine becomes volatile as nicotine. Therefore you can obtain the result with nicotine sulphate by its hydrolysis, which I believe is essentially a correct statement.

MR. WILLIAM MOORE: In dusts you will not have a high degree of hydrolysis since the amount of water present is very small.

MR. RUTH: The amount of water is adsorbed just as the nicotine is adsorbed.

MR. MCCLINTOCK: I would like to ask Mr. Quaintance a question. He knows the severe curculio situation in Georgia. Under those conditions, would there be any advantage in applying a spray or dust earlier than the ones usually put on; then again, another one later, very close to the time of harvest.

MR. A. L. QUAINTANCE: The peach spraying schedule provides for two arsenate of lead applications. On the average, that is about all that it is safe to apply. A plan to put on additional treatments has been followed by several orchardists. In some seasons the injury has not been great; in other seasons the injury has been worse than the curculio or brown rot. I think some of the growers in the Ft. Valley section will this year apply three or perhaps four applications of arsenate of lead. The first application will be made as soon as the blossoms fall. The use of arsenate on the fruit shortly before harvest is to be discouraged. Probably, however, a good many growers will make a fourth application of arsenate at about that time.

The present situation as to the curculio in Georgia is due apparently to weather conditions. For the past two seasons they have had excessive rains and hot weather. The curculio in the course of its life cycle goes into the ground. It is well known to those who have studied this insect that showers, softening the earth, are very favorable to the

emergence of the beetles, whereas dry weather effects the destruction of a great many of them in the soil. Rainy weather furthermore keeps down a number of important parasites.

Under the hot humid conditions in Georgia, the plum curculio has developed apparently a partial second generation, and it is this supposed second generation that is responsible for the large amount of ripe, wormy peaches.

The campaign against the curculio in that section should be to destroy beetles of the first generation by all means possible. Growers will doubtless burn the areas around the orchards, destroy plum thickets, and thus kill the insect in hibernation. They will spray three or four times, collect fallen fruit under the trees that contain the grubs, and perhaps some of them will resort to the old "jarring" method which was discarded with the advent of sprays.

MR. MCCLINTOCK: Do you think that is practical for the Georgia orchards where they have thirty or forty thousand trees?

MR. A. L. QUAINTANCE: It is a question of man power. They have been doing operations on a large scale. The negro help is becoming abundant. They will do the best they can.

That is the reason that dusting has had so much favor and has been so much in vogue in that region. That is one reason why it is fortunate that dusting has a place in peach growing. Conditions are much improved and many of the orchardists are in condition and prepared to carry out extensive programs of curculio repression.

MR. V. I. SAFRO: Just to try to settle some misunderstanding that may yet remain as regards this nicotine discussion, I want to say that both Professor Moore and Professor Ruth are correct. Nicotine sulphate is not volatile, but it doesn't remain nicotine sulphate long under ordinary conditions. The ordinary water, as it is used throughout the United States, has enough elements in it to break down nicotine sulphate, and what you get when it finally reaches the tree is free nicotine which is volatile, so both of these gentlemen are correct. Dr. Moore has an uncanny habit of explaining things that have puzzled us for a long time and made the statement that he wouldn't be surprised to learn that nicotine with sulphur was more effective than nicotine with other materials. That is so, as the result of experiments that have been carried on the past year in three different states. We never could explain just why it was so until Dr. Moore offered the explanation; we were at sea, but it is true. A weaker solution, or rather a weaker nicotine content in a dust in which the sulphur is a carrier seems to be more effective than one in which the clay is a carrier. This is merely a nicotine discussion; I am not recommending any dust.

Just one more point I have in mind here, and that is really an entomological problem and some day at the entomologists' meetings when interest lags, we might start the discussion. It is very doubtful that nicotine functions entirely in its volatile condition. It is more likely a true contact posion and does not function as a gas. That is all I want to say now; I don't want to start anything at this time.

MR. N. J. GIDDINGS: It was suggested by Dr. Lyman, before I gave my paper, that a word as to the activity and interest in regard to this project might not be out of place. Last year the Advisory Board of American Plant Pathologists asked me to act as leader in an endeavor to encourage cooperative work on the dusting project. In this connection a general outline or plan was sent to twenty-six states. Twenty-three of those replied, indicating that the interest was great. Eighteen states were strongly favorable toward further work in connection with dusting, and at least nine states reported experimental work during the season. Seven of them have already turned in data to me. These statements relate particularly to the pathological side. I might add that the outline was not sent generally to the South because it was rather late in the season. This is merely an indication of the interest that the dusting problem has for the whole country.

PRESIDENT WILMON NEWELL: We have undoubtedly gained a great deal of good out of these discussions.

Adjournment.

ARSENIC FOR GRUB-INFESTED SOILS

By J. F. ILLINGWORTH, *Gordonvale, near Cairns, North Queensland*

For some time we have been experimenting with poisons applied to the soil for the control of white grubs, since, as is well known, these pests are a serious menace to the growth of sugar-cane, particularly on the red volcanic soils in North Queensland.

Naturally our earlier experiments were in the laboratory, where the poisons were tried in small pots of soil. This was done by mixing the two together thoroughly before introducing living grubs, which by their natural process of ingesting quantities of soil inevitably absorbed some of the poison. Most satisfactory results were obtained with the ordinary crude white arsenic (arsenious acid).

By using a liberal sprinkling of the arsenic through the soil we found that the grubs all succumbed in from one to four days, and this same result was secured with each repetition of the experiment.

We now have many experiments under way in cane areas that have been regularly devastated, but it will be some time before we can hope for conclusive results, i.e. as to the amount of arsenic required per acre, method of application, etc. Hence I was glad to avail myself of an opportunity to experiment upon troublesome grubs in the garden.

During July and August, cucumbers which had been planted in hills with cowdung, failed completely. They had hardly started to grow before the leaves began to yellow, and the vines became stunted in spite of the fact that they were given an abundance of water. When they were dug out the soil was found to be filled with white grubs; and there was every indication that they had destroyed the small feeding roots. This pest proved to be *Isodon puncticollis* Macleay, commonly known as the Gauger Beetle, because of its destructive habit of digging holes into potatoes and various root crops.

I at once tried the application of arsenic to these hills, using the poison at the rate of about 80 pounds per acre, to see if it would destroy the mature grubs, leaving two hills for checks. About a fortnight later I could only find two live grubs in the four treated hills, while one of the checks had 46 and the other 21 full-grown grubs.

This result was so encouraging that I prepared six new hills on September 27th, and on October 18th, when the soil was full of newly-hatched grubs, I treated five of the hills with arsenic at the same rate, leaving one for a check. A week later, I could find no grubs in the treated hills, though two live beetles were uncovered. The check which was about six feet from the others, had 61 grubs.

An additional experiment was tried, in which the soil and dung were dusted with arsenic at the time that the hills were prepared; in this case, too, a single hill was kept for check. Three weeks later these hills were examined; six live beetles but no grubs were found in the treated hills, while numerous young grubs were in the check.

These results are most encouraging, especially since I have been able to demonstrate that the poison has no detrimental effect upon growing plants, even when used in excessive quantities, i.e. 200 pounds per acre. Furthermore I have found by careful chemical tests, prepared by the mill chemists, that sugar cane grown on land so treated takes up none of the poison—not a trace of it could be found in the juice. Growth on treated soils is most vigorous, so the only possible disadvantage may arise from the action of the arsenic upon soil bacteria, especially if we find it necessary to use the poison in large quantities. This, however, can only be demonstrated after extended application.

Scientific Notes

Possible use of a trap to control Leafhoppers Injurious to Fruit Trees. During the past season in the study of flight and attraction to baits of adults of the European Corn-Borer, at Arlington, Mass., traps were used closely following the "Shaw" moth trap illustrated on Plate 54 of "The Gypsy Moth Report," 1896, by Forbush and Fernald. Instead of female moths, baits were placed in the screen cylinder in the center of the cage. These cages have the advantage of presenting twelve distinct tanglefoot surfaces to catch attracted insects.

It so happened that one of these cages containing, as an attractant, macerated grape-fruit was placed in a large apple tree severely infested by *Empoa rosae*, the rose and apple leafhopper, June 23, 1920.

Several days later this cage was completely covered with thousands of adults of the leafhopper. The trap was placed on the trunk of the tree four feet from the ground and at least three feet below the nearest foliage, so that chance may practically be eliminated in explaining the capture of the insect in such numbers.

The traps are easily and cheaply constructed. Entomologists interested in the problems of leafhoppers injuring fruit trees, may perhaps, find such a trap of assistance in the control of these insects.

GEO. W. BARBER, *Cereal and Forage Insects Division, U. S. Bureau of Entomology.*

THE ENTOMOLOGICAL SOCIETY OF LONDON APPEALS FOR AID

The fine old Entomological Society of London, founded in 1834, and which, since 1875, has been meeting at 11 Chandos Street by the courtesy of the Medical Society of London, has, through the growth of its library, outgrown its quarters and is practically forced to move. It has bought a house at 41 Queen's Gate, South Kensington, near the Natural History Museum, and is leasing a portion of the building to the Imperial Bureau of Entomology. The cost price of the property was ten thousand pounds, an additional sum is required for furnishing.

The cost price has been largely met by subscriptions from members, both as donations and as loans, the loans being secured by a debenture on the property and bearing five per cent. interest. After exhausting the available resources of the resident members, there still remains a sum approximating fifteen hundred pounds, and the Society is making an appeal to foreign members, to entomologists in the dominions, and to interested entomologists in other parts of the world. Donations and loans are received by the Treasurer of the Society, Mr. W. G. Sheldon, who may be addressed at 11 Chandos Street, Cavendish Square, London, W. 1.

The London Society is the oldest of the great entomological societies excepting the Entomological Society of France which was founded a year earlier. Its Transactions and Proceedings have been largely used by American entomologists, and many of the latter when traveling abroad have been welcomed at the meetings of the Society and have cordially been given the use of the magnificent library.—L. O. H.

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The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published as far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceeding publication. Contributors are requested to supply electrotypes for the larger illustrations as far as possible. Photo-engravings may be obtained by authors at cost. The receipt of all papers will be acknowledged.—Eds.

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The high prices and urgent need of maximum production during the war stimulated to a noteworthy degree extension work, both field work and the distribution of suitable literature, and there has been by no means an over-development of this type of activity. There has not been, unfortunately, a corresponding development in providing for the publication of that type of original research which covers considerable ground and requires somewhat extensive bulletins or reports. There have been large and greatly needed developments for extended research without corresponding opportunity for publication and as a consequence, the results of many important investigations are being held until some future time. This is an unfortunate condition not only because all such data are unavailable in large measure to associated workers but on account of the reflex action it is bound to exert upon investigators, most of whom are far from well paid and rightly attach great importance to opportunities for early publication. A continuance of this condition must inevitably react upon investigation because only the most optimistic and idealistic can do their best when over-shadowed by the disheartening probability of long deferred publication. Original work is fundamental to progress along scientific lines and unless the morale of the workers is maintained by adequate provision for both study and publicity, there is bound to be more or less halting or "marking time," a deplorable condition when the urgent need of such studies is recognized. There are splendid groups of investigators throughout the country deeply interested in many problems, some of immediate and others of less direct importance and all making for unrivalled efficiency, except for the one weak point mentioned above. It is very largely as though we had a costly machine splendidly adapted to its purpose and run with a loose connection with the driving wheels, which latter, in scientific work, compare somewhat closely with adequate opportunities for publication.

Obituary

PROFESSOR CHARLES HENRY FERNALD

On February 22, Professor CHARLES HENRY FERNALD passed away at his home in Amherst, Mass.

He was born March 16, 1838, at Mount Desert, Maine. As a boy he assisted his father on the farm and when 15 years of age, went to sea, spending six years on vessels engaged in the West Indian and Coasting trade.

He then entered Maine Wesleyan Seminary to prepare for college, but at the opening of the Civil War, he enlisted in the Navy, where he served for three years, retiring with the rank of ensign.

His desire for an education led him to continue his studies while in the Navy and during a large part of the period, while the naval vessels were on blockade duty, he pursued, alone and without assistance, the studies which would have been assigned to him had he remained in school. This work was so thoroughly done that he was able at the close of his service, to pass the required examination in Bowdoin College, which conferred upon him the degree of M.A.

For one year he was principal of the Academy at Litchfield, Maine, and for five years at Houlton, Maine.

In 1871, he became the first professor of natural history at Maine State College, now University of Maine. During this period, he also studied in the Museum of Comparative Zoology in Cambridge, Mass., and under Louis Agassiz on Penikese Island. He also traveled extensively in Europe, studying insects in the various museums.

After a service of 15 years, he resigned to accept the position of Professor of Zoology and Entomology at the Massachusetts Agricultural College, from which he retired in 1910.

He was entomologist to the Massachusetts Experiment Station from 1887 to 1910, also to the Massachusetts State Board of Agriculture. He was acting president of the college in 1891, and later was the leader in establishing a graduate school in that institution. In 1908 he became director of the graduate school and on retiring from active service, was made honorary director.

Professor Fernald was married in August 1863 to Maria E. Smith, of Monmouth, Me., who later became well known for her work in entomology, particularly on account of the publication of the list of the Coccidae of the world. She was a very thorough student of entomology, was familiar with much of the literature on that subject, and gave unstintedly of her time and effort to assist Professor Fernald in building up a Department of Entomology in the college. She died in October 1919.

When Professor Fernald began teaching at the Massachusetts Agricultural College, his principal lines of instruction were Zoology, Physiology, and many other subjects which had no special relation to natural history. He toiled unremittingly to build up and develop his department and being especially interested in insects, gradually succeeded in developing a department of entomology in that institution.

Beginning with no facilities whatever for the work, he succeeded in securing gradual improvement from time to time and prior to his retirement from active service, was able to see a modern, fire-proof building, constructed and equipped for class-room and laboratory work in entomology and zoology, which will now be known as Fernald Hall.

His son, Dr. Henry T. Fernald, has been connected with the institution for a number of years, and on the retirement of his father, became the head of the department.

Professor Fernald specialized particularly in Micro-Lepidoptera, a group requiring high technical skill and unlimited patience to master successfully. His published works on these insects are models of detail and accuracy. He was a member of many scientific societies and was president of the American Association of Economic Entomologists in 1896.

While all these achievements were notable, perhaps his greatest success was as a teacher. Few men who had any desire to learn or any interest in the subjects which he taught, could fail to be inspired by him. In this respect he was a master, as all of his former students will readily agree.

His kindly interest in all with whom he came in contact, will never be forgotten, and the influences for good that he exerted, not only mark him as a great scientist and teacher, but as a truly great man.

A. F. B.

Reviews

The Coccidae, Tables for the Identification of the Sub-Families, and some of the more Important Genera and Species together with Discussions of their Anatomy and Life History. By ALEX. D. MACGILLIVRAY, pages i-viii, 1-502, Scarab Co., Urbana, Ill., 1921.

This is a comprehensive, morphological, taxonomic and critical account with keys to the sub-families, tribes, most genera and a large number of species. There are also outlines of the life history in the various groups and brief discussions of the economic status of the different forms. The author has compressed within the limits of a moderate sized volume, a summation of practically 50 years of investigation and study by numerous entomologists and has succeeded in producing a work indespensable to all students of the Coccidae and one of great service to entomologists with a less direct interest in the group, because it gives within a small compass an excellent digest of available information.

The work is an outcome of 15 years of study and teaching by the author. He has in this period developed a most excellent technique and as an outcome of his studies he has been able to present a very satisfactory morphological discussion of the entire family, the sub-families, and tribes and throughout the large and varied series of forms, he has employed a nomenclature leaving little to be desired. The volume is primarily for the use of students and is somewhat technical, nevertheless the general discussions of the distribution, life history and habits of the more important groups will be of interest to many professional entomologists and not a few amateurs. Prof. MacGillivray has produced a work destined to take a worthy place is entomological literature.

E. P. F.

Sanitary Entomology, Entomology of Disease, Hygiene and Sanitation, edited by WILLIAM DWIGHT PIERCE. Boston, Richard G. Badger, The Gorham Press, pages I to XXVI, 1 to 518, 88 figs., 1921.

This is an exceedingly valuable, comprehensive, closely indexed resumé of our knowledge of the Entomology of Disease, Hygiene and Sanitation, which had its inception in a class formed in May 1918 among the Entomologists of the country for the purpose of studying recent developments along this line. One need only to turn to the chapter on "Flies and Lice in Egypt" to get a suggestion of the progress which has been made in most civilized countries, though present day practice is very far from what is entirely practicable, if human life and energy are worth conserving.

This book is more than a digest of current information since it embodies and summarizes the investigations and experiences of a group of experts, who have been giving special attention to the varied lines falling within the scope of this volume and at the same time have kept well posted in regard to the activities of other workers. The discovery of the part played by mosquitoes in the dissemination of disease stimulated a very considerable degree of activity, this was followed by material additions to our knowledge of the disease carrying potentialities of other species and the climax was capped by the imperative demand for the control of insect carried diseases during the war,—all summarized in this volume. The work emphasizes the possibilities of prophylaxis resulting from a knowledge of disease carrying insects and methods of controlling them. It covers, however, a broader field, since the authors of the various chapters have recognized the possibilities of further discoveries and have not hesitated to present general discussions of groups likely to be important in this connection, the main effort in this latter being to facilitate ready identifications and to outline the biology. In addition to extended discussions of mosquitoes, house flies and blow flies, fleas and lice, we find a most valuable account of the relation of insects to the parasitic worms of vertebrates, an excellent summary of the types of injury and life history of those flies producing myiasis, somewhat extended accounts of the blood-sucking flies with relation to both life histories and diseases and dissertations upon cockroaches and the diseases which may be disseminated by these pests of the home, a summary of the relation existing between mites and ticks and various diseases, accounts of animal pests and methods of control on both farm and range and a by no means unimportant feature, namely a twenty-four page tabulation of diseases and insect transmission. The exhaustive index and the well selected bibliographies make possible easy reference to original sources of information.

This volume, the product of ten experts in their respective lines should be in the library of every economic Entomologist and will be found an almost invaluable addition to Medical Libraries not only in this country but throughout the world.

E. P. F.

Current Notes

Dr. Clarence H. Kennedy has been appointed instructor in entomology at the University of Tennessee.

Miss Florence Defiel has recently been appointed instructor in entomology at the Univeristy of Minnesota.

Professor Herbert Osborn of the Ohio State University, planned to spend most of the winter in Florida.

Mr. Otis Wade, assistant professor of entomology at the Oklahoma College and Station, resigned September 30, 1920.

Dr. L. O. Howard addressed the Washington Academy of Sciences, February 17, on "How the Government is Fighting Insects."

Mr. G. H. Gale, extension apiculturist of the Bureau of Entomology, has accepted a position with Dadant and Sons, Hamilton, Ill.

Mr. C. S. Rude has been appointed assistant entomologist at the Texas Station in foul brood inspection, *vice* W. E. Jackson resigned.

The Kansas State Beekeepers' Association held its 20th annual meeting at the Chamber of Commerce, Topeka, Kan., February 4 and 5, 1921.

The 32d annual meeting of the California State Beekeepers' Association was held at Oakland, Calif., March 2–5. There was a large attendance.

The West Virginia Beekeepers' Association held a meeting at Charleston, W. Va., March 25–26, and Mr. George S. Demuth was expected to attend.

Doctor F. E. Lutz, former curator of invertebrates, has recently been made curator of entomology in the American Museum of Natural History, New York City.

Mr. Dwight M. DeLong, Scientific Assistant, Bureau of Plant Industry, Harrisburg, Pa., left about the middle of March for a month's collecting in the Florida Everglades.

Mr. Herbert F. Schwarz has been appointed research associate in entomology in the American Museum of Natural History, New York City, and will work in the Hymenoptera.

Doctor A. E. Cameron, Entomological Branch, Canadian Department of Agriculture, resigned October 1, 1920, to accept the professorship of zoology at the University of Saskatchewan.

Mr. I. M. Hawley has accepted, effective July 1, the professorship of zoology and entomology in the Utah Agricultural College and the position of entomologist of the Agricultural Experiment Station.

According to *Science*, the department of biology of McDonald College, has been divided into two departments; botany, and entomology and zoology. The latter is in charge of Professor William Lochhead.

Mr. Arthur Gibson, Dominion Entomologist, Ottawa, Canada, has recently been appointed a member of the Advisory Board on Wild Life Protection, as a representative of the Canadian Department of Agriculture.

Mr. C. E. Smith, Bureau of Entomology, United States Department of Agriculture, stationed at Baton Rouge and co-operating with the University, is carrying on research work with truck crop insects.

In a course of lectures given at El Paso, Texas, under the auspices of the Southwestern Division of the American Association for the Advancement of Science, the subject for March 1 was "Alien Insect Enemies," by Benjamin Druckermaur.

According to *Science*, Mr. Lloyd R. Watson, assistant in apiculture, U. S. Bureau of Entomology, has resigned to accept the position of apiculturist in the Division of Entomology of the Texas Agricultural Experiment Station *vice* H. B. Parks, resigned.

Recent appointments in the Bureau of Entomology have been announced as follows: D. B. Mackie, Cal. Dept. Agr., collaborator; Elmer Johnson, temporarily transferred from Bureau of Public Roads: C. F. Doncette, Mass. Agr. Coll., Doylestown, Pa.,

According to *Experiment Station Record*, Professor J. G. Griffith, head of the department of biology at the New Mexico College, and Station entomologist, resigned August 20, 1920, to accept a position in the Pasadena, Cal., High School, and was succeeded by Doctor Robert Middlebrook.

Doctor E. M. Walker, University of Toronto, for eleven years editor of *Canadian Entomologist*, retired as editor January 1st, 1921, and is succeeded by Doctor J. McDunnough, Entomological Branch, Department of Agriculture, Ottawa, Canada, to whom manuscripts for publication should be sent.

The Maine State Beekeepers' Association was organized at Auburn, Me., on February 15. L. W. Longfellow, Hallowell, was elected president, and F. L. Mason, Mechanic Falls, secretary. The first annual meeting was held March 30, at Orono, Doctor E. F. Phillips was scheduled as one of the speakers.

Mr. W. E. Anderson, State Entomologist, is employed by the Department of Agriculture and Immigration of the State of Louisiana and has immediate charge of all the State's regulatory work relating to nursery stock, the pink bollworm, citrus canker, and other insects and diseases attacking cultivated crops.

The following appointments have been announced in the Entomological Branch, Canadian Department of Agriculture: E. P. Donat, Inspector, brown-tail moth work, Nova Scotia; Gilbert Garlick, temporary junior entomologist, Vineland, Ont.; Doctor F. C. Craighead, Division of Forest Insects, Ottawa; Miss Agnes Healy, temporary clerk stenographer, Vernon, B. C.

The following transfers in the Bureau of Entomology have been announced: Perez Simmons, Alhambra, Cal., to Washington, D. C.; George H. Bradley, Mound, La., temporarily to Federal Horticultural Board; A. J. Ackerman, Bentonville, Ark., to California; C. H. Alden, Wallingford, Conn., to Fort Valley, Ga.; M. T. Young and Robert L. Saul, temporarily to the Federal Horticultural Board.

Mr. George N. Wolcott, formerly of the U. S. Bureau of Entomology and Bureau of Plant Industry studying the possible relation of insects to the transmission of mosaic disease of sugar-cane, and more recently entomologist of the Estacion Agronomica, Haina, Santo Domingo, Republica Dominicana, has severed all connection with the latter instutition and is now entomologist at the Insular Experiment Station, Rio Piedras, Porto Rico. His address is Box 1281, San Juan, Porto Rico.

At the 13th annual meeting of the Quebec Society for the Protection of Plants held at MacDonald College, Quebec, the following addresses or papers were presented by members of the Branch staff: "The Organization of the Entomological Branch," Mr. A. Gibson; "The Discovery of the European Corn Borer," L. S. McLaine; "Spraying versus Dusting," C. E. Petch; "Chemical Investigations of Sprays," A. Kelsall. Mr. H. G. Crawford, of the Division of Field Crop and Garden Insects, also attended the meetings.

The following additions to the staff of the Japanese Beetle Laboratory at Riverton, New Jersey, have recently been made: R. W. Kelley, formerly entomologist for the Sherwin-Williams Company; A. S. Mallorey, from Rutgers College; L. B. Smith, formerly of the Virginia Truck Experiment Station at Norfolk, Va.; T. H. Frison, of the University of Illinois. Doctor William Moore of the University of Minnesota will also carry on special work at the laboratory this season, having obtained six months' leave of absence from the University.

It was announced some time ago that Mr. T. H. Jones had been appointed State Entomologist of Louisiana. This was an error. At the Louisana State University and Agricultural and Mechanical College, Mr. O. W. Rosewall, Associate Professor of Entomology, teaches this subject, while Messrs. T. H. Jones and W. G. Bradley, Entomologist and Assistant Entomologist respectively, of the Agricultural Experiment Stations are engaged in research work, more particularly with insects injurious to corn and live stock. Mr. E. C. Davis is Apiculturist of the Extension Division of the University.

The work of Mr. C. L. Marlatt as Chairman of the Federal Horticultural Board has necessitated his relinquishment of the direction of Tropical and Subtropical Fruit Insect Investigations, and Doctor Howard has combined this branch with the office of Deciduous Fruit Insect Investigations. Mr. Marlatt will, however, maintain active co-operation in certain projects, as Mediterranean fruit fly investigations, the work under way in the Canal Zone, systematic work with Coccidae, and investigations of insects injurious to greenhouses, on account of the intimate relation of this work with certain quarantine and other work of the Board.

A conference of Hessian fly men of the branch of Cereal and Forage Insect Investigations, Bureau of Entomology, was held at the entomological field station at West Lafayette, Ind., on January 3. The persons attending this meeting were: W. R. Walton, W. H. Larrimer, A. F. Satterthwait, J. R. Horton, C. K. Fisher, R. A. Blanchard, H. R. Painter, G. B. Pearson, W. B. Cartwright, G. G. Ainslie, P. R. Myers, and C. C. Hill. It was the unanimous opinion of those present that the conference resulted in great benefit to the Hessian fly investigations, and the hope was expressed that similar meetings might be held from year to year.

At the request of the Navy Department, arrangements have been perfected for the periodic inspection of food commodities stored at the Naval Supply Base, South Brooklyn, N. Y. Doctor E. A. Back and Perez Simmons of the Bureau of Entomology recently spent two days in Brooklyn going over the situation. The accidental infestation of supplies of brown sugar by cadelle larvae and infestation of fur-lined boots, coats, and other clothing by clothes moths were the interesting features of the inspection. In the clothing department there was located a badly damaged lot of submarine boots and aviator helmets and chin protectors from which adult clothes moths were spreading, infesting the entire establishment.

The official entomologists of Ohio, Indiana, Illinois and Missouri met at Lafayette, Indiana, March 15-16, to discuss problems in their respective states, to plan the season's work and to handle results in such a way as to make them comparable.

Such important problems as the Hessian fly, chinch bug, joint-worm, codling moth, peach tree borer, potato leaf hopper, cut-worms, etc., were thoroughly discussed. Those present included S. A. Forbes and W. P. Flint, of Illinois; H. A. Gossard and T. H. Parks, of Ohio; L. Haseman, of Missouri; W. H. Larrimer, H. R. Painter, and G. B. Pearson, of the U. S. Bureau; and F. N. Wallace, H. F. Dietz, J. Troop, W. A. Price, and J. J. Davis, of Indiana. It is planned to make this conference an annual event.

Doctor T. E. Snyder, Bureau of Entomology, left Washington on January 16 for New York where a consultation with engineers of the American Telephone and Telegraph Company was held on January 17, in regard to control experiments to be conducted against the cable borer (*Scobicia declivis* Lec.). A manuscript is being prepared by members of the branch of forest entomology on this insect and the results of experiments to date. January 18 to 24 was spent by Doctor Snyder at the Museum of Comparative Zoology doing systematic work on exotic termites, particularly new Central American species. Some time was spent with Doctor C. B. Thompson at Wellesley College working on the biology and morphology of Nearctic termites.

Mr. E. H. Strickland of the Entomological Branch, Canadian Department of Agriculture, returned to Ottawa on February 4th from England, where he visited the British Museum, the Liverpool School of Tropical Medicine, and several docks and grain warehouses in connection with an inquiry regarding acarid infestation of Canadian wheat. Though mites are rarely found in grain while it is in storage in Canada, they were found in considerable numbers in parcels that had been held for some months in English warehouses. This inquiry followed arrangements which had been made with Professor R. Newstead, of Liverpool, and Doctor J. F. Birchard, of Winnipeg, for a co-operative investigation on the susceptibility of Canadian wheat to infestation by mites.

The semi-annual meeting of the Nova Scotia Entomological Society was held in Halifax on February 9th. In the absence of the President, Professor Brittain, of Truro, the Vice-President, Mr. J. D. Tothill, of Fredericton, occupied the chair. In addition to Mr. Tothill, Messrs. Sanders, Durling and Gilliatt, of Annapolis, and Keenan and Dustan, of Fredericton, were present. The following papers were presented by members of the Branch: "Our Arsenic Supply," G. E. Sanders; "Fungous Diseases as Factors in the Natural Control of Insects," A. G. Dustan; "The European Corn Borer," W. N. Keenan; "The Brown-tail Moth," F. C. Gilliatt; "Results from Spraying in 1920," V. B. Durling. In order that the Society may include as members residents in all the maritime provinces, its name was changed to the "Acadian Entomological Society."

The twelfth annual meeting of the British Columbia Entomologcal Society was held in Vancouver on February 12th, 1921. Mr. R. C. Treherne was re-elected Vice-President for the Interior district, and Mr. W. Downes Hon. Secretary-Treasurer. The following papers were presented by officers of the Branch: "A Review of Economic Entomology in B. C.," R. C. Treherne; "Notes on the Fauna and Flora of Mt. McLean," R. Glendenning; "Notes on *Amnesia decorata* and the Holly Bud Moth," W. Downes; "Forest Insect Conditions," Dr. J. M. Swaine; "Notes on the Satin Moth," R. Glendenning; "Collecting Places in northern B. C.," W. B. Anderson. Mr. Buckell gave a talk on "The Ecological Distribution of some Orthoptera from the Chilcotin district," and Mr. W. H. Lyne on "Insects Imported from the Orient." The following entomologists were also present at the meetings: Messrs. Ruhman, Venables, Blackmore, Cockle, and Day.

C. H. Fernald